POST-HARVEST HANDLING OF AGRICULTURAL CROPS

AGH-440
Course Contract

- **Title of Course**: Post-harvest of Agricultural Crops
- **Credit**: 3(2-1), Course: 14 x, Practicums: 12x
- **Objective**: After finishing this course, students will be able to explain the techniques of post harvest handling of agricultural crops
- **Lecturer**:
  - Food Crops: Sugiyanta, Heni Purnamawati
  - Horticulture: Bambang SP, Slamet Susanto, Dewi Sukma
  - Plantations: Ade Wachyar, Supijatno, Haryadi
  - Practicum: Juang Gema Kartika, Dewi Sukma, Heni Purnamawati, Supijatno, Adewachyar, Nandang Hasanudin, Sapti, Sefa, Irman
- **Grade Proportion**: Mid Test 40 %, Final Test:35 %, Practicum: 25 %
- **The presence of course**: full (permit *case by case*)
- **The presence of practicum**: full
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<th>Date</th>
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<th>Lecturer</th>
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<td>1. Preliminary</td>
<td>Thursday 07/09/17</td>
<td>09.30 – 11.10</td>
<td>SUG</td>
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<td>2. Criteria and harvesting techniques</td>
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<tr>
<td>1. Cleaning, sortation and grading</td>
<td>Thursday 14/09/17</td>
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<td>2. Size reduction</td>
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<td>3. Drying</td>
<td>Thursday (Change/Holiday)</td>
<td>09.30 – 11.10</td>
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<td>4. Cooling</td>
<td>Thursday 28/09/17</td>
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<td>2. Packaging</td>
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<td>3. Storage</td>
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<td>5</td>
<td>1. Post harvest Pest and Disease</td>
<td>Thursday 5/10/17</td>
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<td>2. Quality Management and Food safety</td>
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<td>6</td>
<td>Post Harvest Handling of Rice</td>
<td>Thursday 12/10/17</td>
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<td>Post Harvest Handling of Tuber and Legume</td>
<td>Thursday 19/10/17</td>
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<td>Post Harvest Handling</td>
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<td>8</td>
<td>of Coconut</td>
<td>Thursday 26/10/17</td>
<td>09.30 – 11.10</td>
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<td>9</td>
<td>of Tea</td>
<td>Thursday 2/11/17</td>
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<td>10</td>
<td>of Rubber</td>
<td>Thursday 9/11/17</td>
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<td>11</td>
<td>of Coffee</td>
<td>Thursday 16/11/17</td>
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<td>Post Harvest Handling of Horticulture Crop</td>
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<td>13</td>
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<td>09.30 – 11.10</td>
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<td>14</td>
<td>Post Harvest Handling of Horticulture Crop</td>
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<td>Preliminary</td>
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<td>Penentuan Saat Panen</td>
<td>Thursday 14/09/17</td>
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<td>Analysis of Sugar, Acid, Starch</td>
<td>Holiday</td>
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<td>Sorting and Grading</td>
<td>Thursday 28/09/17</td>
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<td>Rice Mill</td>
<td>Thursday 5/10/17</td>
<td>13.00-15.00</td>
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<td>Analysis of Physicochemical and Eating Quality.</td>
<td>Thursday 12/10/17</td>
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<td>The Hardness, Chlorophyl and Colour Chart Analysis</td>
<td>Thursday 19/10/17</td>
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<td>Post Harvest Project</td>
<td>Thursday 26/10/17</td>
<td>13.00-15.00</td>
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BRIEF DESCRIPTION

- Definition and scope of post-harvest handling
- Criteria and harvesting techniques
- Drying and Cooling
- Cleaning, sorting and grading
- Grinding (size reduction) and minimal processing
- Packaging and Storage
- Post-Harvest Pests and Diseases
- Quality Management and Food Safety, Standards: SNI, ISO, Codex, Evaluation
- Post-harvest handling techniques in food crops: Cereals and Tubers
- Post-harvest handling techniques of horticultural crops: fruits, vegetables and flowers
- Post-harvest handling techniques of plantation crop, oils, baverage and sap.
REFERENCES

DEFINITION OF POST-HARVEST HANDLING

- Post-harvest: all activities from harvesting to be material which are ready to be consumed.
- Primery post-harvest: all activities from harvest to be raw material which are ready to store or to the next process.
- Secondary post-harvest: all processing activities of agricultural product up into finished products or ready to be consumed.
Definition

- **Postharvest** handling is the stage of crop production immediately following harvest, including cooling, cleaning, sorting and packing.
- The post-harvest sector includes all points in the value chain from production in the field to the food being placed on a plate for consumption. Postharvest activities include harvesting, handling, storage, processing, packaging, transportation and marketing.\footnote{1}
Regardless of the scale of harvest, from domestic garden to industrialised farm, the basic principles of post-harvest handling for most crops are the same: handle with care to avoid damage (cutting, crushing, bruising), cool immediately and maintain in cool conditions, and cull (remove damaged items).
SCOPE OF POST-HARVEST HANDLING

- Determining the time due to harvest and harvest technique
- Cleaning, grading, and sortation
- Material handling
- Drying and cooling
- Milling (size reduction)
- Packing and storage
- Quality management
THE IMPORTANT OF POST-HARVEST

- To maintain production both quantitative and qualitative
- To sustain agriculture product in both distance and time dimension because harvest crops usually seasonal and cultivated only in certain ecological.
- Post-harvest technology needed to match between the commodity with a machine tool so that can be operated efficiently.
- Agricultural wastes can be utilized and provide economically value-added.
- Reducing of losses of both quantity and quality
- Secondary post-harvest handling (processing technology) can make the products ready to be consumed, easily transported and more useful.
What happens after harvest?
HARVEST CRITERIA

- Agronomic yields are a parts of crops that economically valuable.
- Cereals: grain
- Crops: tuber
- Vegetables: leaves, fruits, flowers, roots, stems
- Fruit: Fruit
- Criteria for time due to harvest: the weight or the maximum number and maximum quality
- Cereals: physiological ripe: when dry weight of grains are maximum.
- Rice: milk ripe, dough stage, yellow ripe, ripe.
- Criteria for an optimum harvest: minimum water content, maximum of milled rice yield, head rice yield maximum and the green grains were minimum.
- Criteria for the corn, when has emerged the black layer
THE DETERMINATION OF HARVEST AND HARVEST

OPTIMUM HARVEST TIME

day After Heading
STAGE OF FRUIT AND VEGETABLE LIFE

- Post-harvest physiologists distinguish three stages in the life span of fruits and vegetables: maturation, ripening, and senescence.

- Maturation is indicative of the fruit being ready for harvest. At this point, the edible part of the fruit or vegetable is fully developed in size, although it may not be ready for immediate consumption.
- Ripening follows or overlaps maturation, rendering the produce edible, as indicated by taste.

- Senescence is the last stage, characterized by natural degradation of the fruit or vegetable, as in loss of texture, flavour, etc. (senescence ends at the death of the tissue of the fruit).
DEFINITION

Mature: growth and development has been perfect / complete (meaning from the dictionary); often synonymous with ripe

Stage where the commodity is guaranteed perfect ripe process in a timely

Stage where the commodity has reached a sufficient stage of development and post-harvest and post-harvest handling (including their ripening), at least minimally qualified consumers

Horticultural Maturity: the stage of development when the plants or parts of plant fulfill the requirements for use by consumers for a particular purpose
ESTIMATE MATURITY

CHRONOLOGY
* time after planting, time after full flowering
* rarely perfect, to planning, is relatively widely used
* is often combined with a heat unit

PHYSICAL CHANGES
* The shape, size, surface character
* Regional abscission: the oldest method
* Texture: maturity followed by softening

CHEMICAL CHANGES
* Maturity followed by changes in the composition
* Widely used; less satisfactory; complicated measurement
CHANGE OF PHYSIOLOGY
Maturation-related changes in physiology (respiration and ethylene production). Measurement complicated and expensive; greatly vary on the same commodity.
The production of ethylene is used to index the particular maturity in apples stored at CA.

PREDICT MATURITY
* Predicting maturity is more complex than assessing maturity at harvest.
  * Terms basics: measuring changes during development can be modeled mathematically • time to reach maturity index can be predicted
  * Measurements in early development can be used to predict the maturity date of a commodity reaches the minimum acceptable
CHEMICAL CHANGES DURING MATURATION

FRUIT

Color
* Change the look; primary criteria for consumers
* The loss of green color and the appearance of red, yellow, blue
* Who was responsible in a loss of green color is lost khlorofil (pH changes, oxidative system, enzyme khlorofilase)
* Who is responsible for the appearance of a color other than green is the synthesis of carotenoids and anthocyanins

Carbohydrate
* Changes in starch into sugar, influencing flavors (sweet) and textures (soft), more easily acceptable to consumers
* Solving protopektin and hemicellulose polymers into simpler compounds (low BM) is easily soluble role in water weakens the cell wall. The rate of degradation of the pectin compound is directly related to softening.
CHEMICAL CHANGES DURING MATURATION (Cont)

3. Organic acid

- Generally, the organic acid content decreased during ripening (except bananas and pineapples)
- * sources of energy reserves in fruit

Compounds Containing Nitrogen

- The content of protein and free amino acids are low, do not play a role in determining the quality of
- The change shows the difference in metabolic activity
- climacteric phase → amino acids decreased
- senesence → increase in free amino acids
CHEMICAL CHANGES DURING MATURATION (Cont)

5. SCENT
   • Participate in the development of optimum quality
   • Synthesis of volatiles during ripening; <1% of total C
   • Ethylene 50-75% volatile (main), non-scented
   • Fruit flavour non klimakterik not synthesize as much as climacteric fruit

5. VEGETABLES
   • Sudden changes in metabolism does not occur (except bean sprouts)
   • Seeds and pods full fledged low metabolism (water content 15%)
   • Seed young as fresh vegetables high metabolism; moisture content 70%; with maturation sugar -> starch, fiber, KA decreased
CHEMICAL CHANGES DURING MATURATION (Cont)

* Bulb, roots and tubers at harvest has a low metabolic rate, dormant can be extended

* Flowers, buds, stems, leaves vary in metabolic activity and the rate of deterioration, if wilted, appearance, texture and nutritional value greatly reduced
Varies depending on the type of commodity

<table>
<thead>
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<th>Commodity</th>
<th>Harvest Criteria</th>
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<tr>
<td>Leafy and Fruit Vegetable</td>
<td>Horticultural Maturity, Physiological Maturity, Ripeness</td>
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<tr>
<td>Carrot</td>
<td>Size of root</td>
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<td>Raddish</td>
<td>Days from planting</td>
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<td>Potato</td>
<td>Drying foliage</td>
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<td>Garlic and Onion</td>
<td>Drying of tops, neck tissues begin to soften</td>
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<tr>
<td>Sweet Potato</td>
<td>Senescence of vines</td>
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Minimum juice values for mature citrus

<table>
<thead>
<tr>
<th>Citrus fruit</th>
<th>Minimum juice content (%)</th>
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<tr>
<td>Naval oranges</td>
<td>30</td>
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<tr>
<td>Other oranges</td>
<td>35</td>
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<tr>
<td>Grapefruit</td>
<td>35</td>
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<tr>
<td>Lemons</td>
<td>25</td>
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<tr>
<td>Mandarins</td>
<td>33</td>
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<tr>
<td>Clementines</td>
<td>40</td>
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**Harvesting system**

**Purpose:**
1. Gathering the yield
2. Appropriate level of maturity
3. Minimize damage and loss
4. fast
5. cheap

**Harvest manual (hand harvesting)**
(Fruits, Vegetables, Flowers)

**Advantages Hand Harvesting**

1. Humans can accurately select maturity
   - Grading to be accurate
   - Allows harvesting stages
2. Minimal crop damage
3. Harvesting can be improved by increasing labor
4. Investing is not expensive
The problem in hand harvesting

1. In some countries, not all year round availability
2. If workers strike in the period of harvesting
3. Labor regulations
4. need training
5. Maintaining productivity

Harvesting with Machine

Advantages:
1. Potential for rapid harvesting
2. Work atmosphere better
3. Problems salaries and reduced labor
Problems in the use of harvesting machines

1. Workers should be well-trained
2. Surgical error will cause huge loss
   - Damage to the machine
   - Damage to crops
3. Regular engine maintenance should be performed
4. Crops yield should match with the machine design
   (eg: - the tree should be short
   - The stem should be long enough
   etc.)
5. Planting pattern should be adjusted
6. Choice commodities grown to be limited
7. Not able to select harvest
8. High levels of crop damage
9. Expensive
10. Equipment becomes obsolete before the investment return (loss)
11. Social impact
14. Need new cultivars that allows the use of harvesting machines
Grains may be lost in the pre-harvest, harvest and post-harvest stages. Pre-harvest losses occur before the process of harvesting begins, and may be due to insects, weeds and rusts. Harvest losses occur between the beginning and completion of harvesting, and are primarily caused by losses due to shattering.

Post-harvest losses occur between harvest and the moment of human consumption. They include on-farm losses, such as when grain is threshed, winnowed and dried, as well as losses along the chain during transportation, storage and processing.
- All agricultural crop products are subject to damage that causes losses.
- Causes of damage: microbial, enzymatic, and chemical.
- Microbial: agricultural products can be infected with microbes that can decompose the products that causes odor and toxic compounds.
- Enzymatic: decomposition of fats, carbohydrates or proteins into smaller molecules that cause discoloration or browning.
Some activities to prevent losses:
- Reduction of moisture content
- Decrease or increase in temperature (cooling or pasteurization)
- Chemical treatment
- Fermentation.