

Harvest and post-harvest of fruit crops

Stages of ripening

- **Mature fruit:** a fruit that has reached such a stage of development on the plant that it will ripen following harvest
- **Ripe fruit:** a fruit that is ready to be eaten
- **Under-ripe fruit, Immature fruit**
- **Mature fruit (firm ripe)** – firm but still mature enough to ripen; withstanding travelling to distant markets; avocados, bananas, apples, pears, kiwifruits requires ripening period before they become edible
- **(Fully) ripe fruit** – sugar content reaches its maximum, prime dessert quality, not suitable for storage and long transport
- **Overripe fruit**

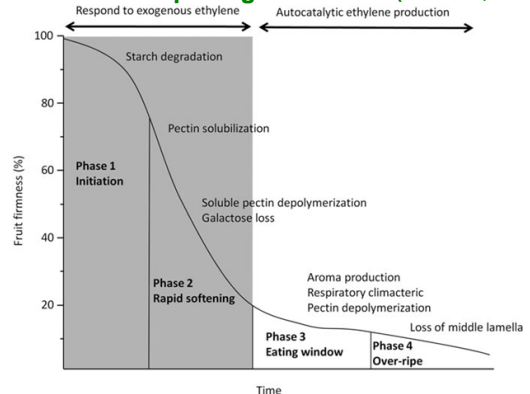
Characteristics of the harvest

- Expensive – requires a lot of hand labour or specialised, expensive machinery
- Must be accomplished carefully and within a relatively short time
- Should be planned well in advance
- Fruit quantity and optimum harvest time can be predicted precisely
- Prediction of quantity – number of flowers/fruits, harvesting sample trees
- Prediction of harvest time – based on maturity/harvest indices; recommended to use at least two indices for setting a harvest date

Classification of fruits based on their ripening characteristics

- **Fruits ripen continuously** – e.g. strawberry, raspberry, blackberry
 - **Fruits ripen at once** – e.g. apple, pear, cherry, currant
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- **Non-climacteric fruits:** citrus fruits, grape, fig, cherry, strawberries, raspberries, blackberries, pineapple
 - **Climacteric fruits:** banana, apple, pear, (apricot, peach), mango, papaya, avocado, kiwifruit, persimmon

Post-harvest ripening of kiwifruit (Atkinson, 2011)



Prediction of harvest time - Harvest indices 1.

- **Basis for forecasting methods:**
- Days after full bloom
- Heat units – growing degree hours
- **Basis for quick, practical methods:**
- Fruit colour – ground and surface colour; colour charts
- Flesh firmness – pressure testers, destructive or non-destructive
- Fruit removal force – pull force gauge
- Seed coat colour
- Fruit size, fruit shape

Prediction of harvest time - Harvest indices 2.

- Basis for „laboratory” methods:
- Soluble solids content (Brix°) – refractometer
- Hydrolysis of starch
- Acidity, sugar:acid ratio
- Tissue ethylene content
- Aroma volatiles – electronic nose

- Sonic resonance
- NIR reflectance

Types of harvesting machines

- Tree shakers
 - shake down fruits from the tree which are falling to a catching frame (stone fruits) or collected from the ground (nuts)
 - trunk shakers for smaller trees
 - limb shakers on large trees
 - more efficient for fruit situating on spurs than on long shoots
- Canopy shakers - currant and raspberry harvesters
 - machines employing rotating sticks
 - machines employing pulsating air jets

Factors determining storability of a fruit

- Its species
- Its cultivar
- Stage of maturity
- Environmental circumstances (soil, precipitation)
- Its production technology (fertilization, irrigation, plant protection, harvest method)
- Extent of disease and insect infection
- Extent of mechanical damages
- Storage method, storage circumstances

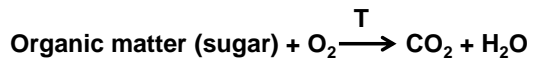
Harvesting methods

- **Manual**
- fruits are removed from the trees by hand or by hand spears
- employs ladder, mobile picking platform; fruits are placed into bins, crates, etc.
- selective, multiple harvest is possible
- mainly for fresh and dessert market
- **Mechanical**
- fruits are removed by machines
- causes more damage to the plants, to the fruits
- training system should be adjusted to the harvest method
- fruits are collected in crates or bulk containers
- for nuts and processing purposes

Factors determining harvest efficiency

- „Quality” of the workers
- Harvest method
- Machinery and integument (crates, bulk bins, etc.) supply
- Training system (shape and size of the tree)
- Fruit size
- Yield

Process of respiration:



Decreasing the rate of respiration is possible by:

- decreasing the temperature
- decreasing the O₂ level
- increasing the CO₂ level
- increasing the relative humidity

Storage methods

- Ventilated storage
- Refrigerated storage – temperature and relative humidity are regulated
- Controlled atmosphere (CA) storage – O₂ and/or CO₂ levels are also regulated

Optimum storage conditions:

- Temperature: 1-4°C for temperate zone fruits, around 10°C for tropical fruits
- Relative humidity: 80-95%
- O₂: 2-3% (for some species not that low)
- CO₂: 2-3% (for some species even more)

Post-harvest procedures 1.

- Storage
- Reception of produce
- **Pre-cooling** – removing field heat; hydrocooling, forced air cooling
- **Sorting** – removal of diseased, damaged, deformed fruits, which don't meet the minimum requirements
- **Cleaning** – removal of contamination; dry method (dusting), wet method (washing)
- **Chemical treatment** - disinfection
- **Drying**

Packaging materials, methods

- Net
 - Bag
 - Basket
 - Hamper
 - Carton
 - Crate
 - Bulk bin
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- Sealed packaging
 - Modified humidity packaging
 - Modified atmosphere packaging (MAP)
 - Intelligent packaging

Structure of EU's marketing standards

- 1) Definition of produce
- 2) Provisions concerning quality
 - a) minimum requirements
 - b) classification: extra class, class I, class II
- 3) Provisions concerning sizing – minimum size, size categories
- 4) Provisions concerning tolerances
- 5) Provisions concerning presentation – packaging, uniformity
- 6) Provisions concerning marking – nature of produce, identification (grower, shipper), origin of produce, commercial specifications (grade, size, package weight/count)

Post-harvest procedures 2.

- **Grading** – categorizing the fruits according to difference in their weight, size, colour, maturity
- **Waxing** – reducing water loss, improving appearance
- **Packing and packaging** – helping the transport, protection of produce, providing information, boosting sales appeal
- Transport