



BASIC TECHNICAL GUIDELINES FOR THE **HARVEST, PACKAGING** AND **STORAGE OF** **SOFT FRUITS**

Author:
Prof. Boris Pasalic



BASIC TECHNICAL GUIDELINES FOR THE **HARVEST, PACKAGING** AND **STORAGE** OF **SOFT FRUITS**

Fruits
remain alive
even after
harvesting
and should be
cared for.

Timely
harvesting
leads to
better
profits.

After harvesting
berries, losses
can reach up
to 50% due to
inadequate
handling.

Fruit quality is
achieved in the
orchard, and
post-harvest
measures
extend it.

Rapid cooling
of soft berries
after harvest
saves your
money.



Author: Prof. Boris Pasalic

Berries remain alive post-harvest. They respire, release heat and moisture, age, and eventually decay. Their primary role is safeguarding the developing seed inside. As the seed matures, the fruit initiates decay processes, facilitating the seed's release onto the soil surface for germination and new plant growth. Our task is to delay these natural processes, extending the fruit's marketable lifespan by enabling the storability of the fruit as long as possible.

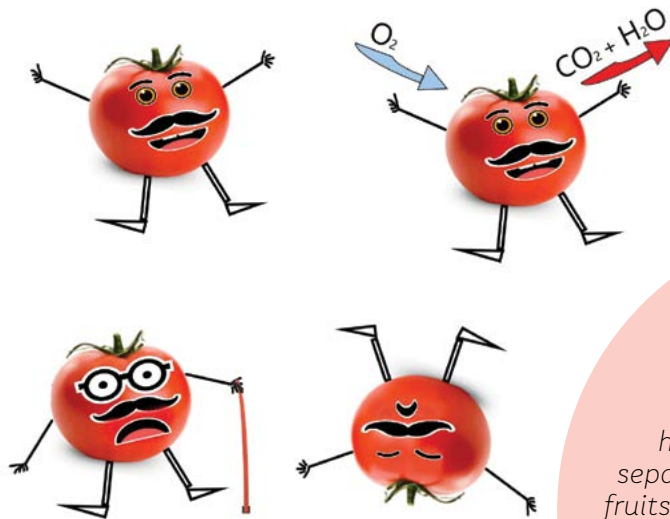


Figure 1: The common trait among all fruits is their ability to continue living even after harvesting, that is, after being separated from the plant. Harvested fruits respire, release moisture, wrinkle, age, and eventually decay entirely. It's essential to understand these processes to slow down their dynamics and preserve the fruit in a market-acceptable state for as long as possible.



The key to fruit quality lies in the orchard or vegetable garden. Cutting-edge cold storage can't rectify poor quality stemming from the plantations (cold storage isn't a hospital for fruits). Conversely, excellent fruits cultivated in orchards or gardens can be entirely spoiled due to improper handling after harvest.

Proper treatment of fruits after harvest includes:

1. Harvesting fruits at their prime time (considering their intended use).
2. Adequate harvesting technique and ensuring careful transportation of fruits to storage or market
3. Sorting and storage of fruits in adequate conditions
4. Packaging fruits in appropriate containers and marketing

STRAWBERRY

In the case of strawberries, all phenophases of fruit growth occur simultaneously on the plant: from newly opened flowers to fully ripe fruits. Strawberry harvesting is typically done by hand and often directly packed for market distribution (strawberries don't endure adverse effects from shaking, re-packaging, sorting, washing etc.). During harvesting, it's essential to prioritize the pickers' hygiene. Strawberry fruits don't endure mechanical pressure, throwing, rolling, etc., factors that should be considered during the fruit-picking process.

The development of a strawberry fruit from a green fruit (1) to an overripe fruit (8) is illustrated in Figure 2 on the right. Harvesting is typically done in phase 6 (for fruits intended for extended storage or distant markets) and in phase 7 (for immediate market distribution of fruits). Fruits in phase 8 are considered overripe and are suitable only for processing.

Strawberry fruit falls under the category of non-climacteric fruits, which means that it cannot ripen later after harvesting, that is, during storage and sale.

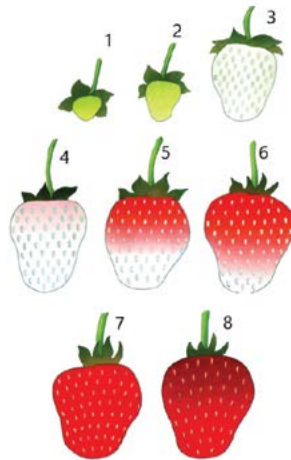


Figure 2: Strawberry harvesting occurs multiple times because the fruits do not ripen simultaneously, that is, at the same moment on the plant, fruits are in all stages of development—from just formed to fully ripe (on the left). Harvest timing primarily relies on the fruit color, indicating a specific stage of ripeness (on the right).



Figure 3: The fruit is not detached from the stem by tearing or pulling but is lightly held in the palm (left image), and the stem is cut using the thumb and forefinger (right image). Any pressing of the strawberry fruit with fingers quickly results in damage or watery depressions, where fungal diseases often develop.



Figure 4: In rare cases, for firm fruits or specific strawberry cultivars with easily detachable fruits, harvesting is performed by gently twisting the fruit, as demonstrated in the above photos.

Strawberries are highly sensitive to high temperatures and rapidly lose water. At 15°C, strawberry fruits lose 0.5% of their mass within two hours, and at 30°C, it's as much as 2.5%. Fruits exposed to direct sunlight for 4 hours (30°C) lose 40% of their commercial value due to a temperature 5-10°C higher than the surrounding air. It's crucial to shield the fruits from direct sunlight and transport them to warehouses within two hours of harvesting.



Figure 5:

Strawberry fruits are commonly harvested directly into the packaging intended for market distribution.

When picking, it is advisable to use a cart with the packaging on it, allowing pickers' hands to be free, and the packaging easily reachable.

During harvesting maintaining high hygiene is crucial. Fruits can be contaminated by various pathogens that lead to human diseases, transmitted through unclean hands.

Figure 6: The cooling of strawberry fruits primarily occurs in cooling tunnels (left image) or conventional cold storage rooms. where a significantly smaller quantity of fruits is brought in and cooled compared to the capacity of the storage, ensuring more efficient fruit cooling.

Any cooling process post-harvest significantly prolongs the shelf life of strawberry fruits.



The most effective method involves cooling the fruits within 2-3 hours (pre-cooling, fruit cooling). The optimal way for strawberries is cooling within a strong, cold air. The cooling duration depends on fruit temperature, packaging type, cooling system, etc. (0.3 - 2 hours). Properly cooled fruits, harvested at the 3/4 coloration stage (phase 6, image 2 on the right), can be successfully stored for 8 to 10 days at 0°C, maintaining a relative humidity of 90 - 95%.

TYPES OF PACKAGING FOR HARVESTING STRAWBERRIES:

Conditions we have dictate the use of wooden storage crates, dimensions 30x50 cm. These are most commonly used for harvesting strawberries, and lately, cardboard packaging of various dimensions has also been used. Strawberry fruits are sensitive to pressure, which should be considered when harvesting into larger containers (the lower fruits endure pressure from those above, resulting in damage and spoilage).

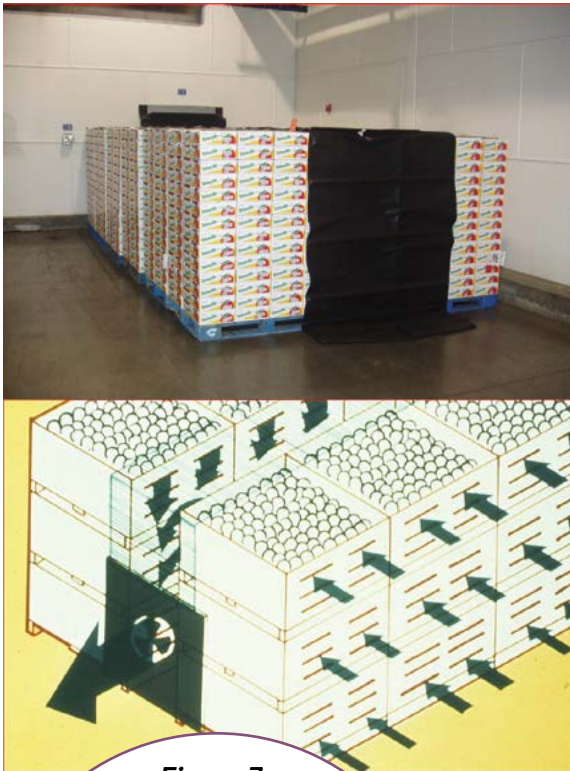


Figure 7:
The cooling of strawberry fruits can also be conducted in refrigerators equipped with a built-in fan in the wall. This fan draws cold air through the packed fruits, effectively dissipating heat from them. The airflow's direction is illustrated in the drawing on the right.



Figure 8: Wooden (on the left) and cardboard (on the right) packaging for harvesting strawberries

Strawberry fruits can be gathered in plastic baskets, with or without a lid, used to pack 0.5 or 1 kg of fruits. It's advisable to harvest directly into these baskets rather than repackaging from larger containers since strawberries are sensitive to handling. These baskets are then placed into wooden or cardboard boxes for storage or sent to the market. Strawberries can be packed in plastic bags with varying degrees of perforation, allowing gas exchange. After harvesting, prompt cooling is crucial to reduce respiration intensity and moisture loss, thereby extending the period they remain fresh.

STRAWBERRY STORAGE CONDITIONS:

Fresh strawberry pods can be stored for 7 to 10 days. The ideal storage temperature should be maintained at 0°C, with a relative humidity between 90 - 95%. The critical lowest temperature (where fruit tissue gets damaged) stands at -0.8°C. When stored in ULO (Ultra-Low Oxygen) chambers, ensure the following gas composition: 5-10% O₂; 15 - 20% CO₂.



Figure 9:

Strawberry fruits are either packed in plastic baskets with a lid (on the left) or in plastic bags designed to be selectively permeable for gas exchange (MAP packaging, on the right).

RASPBERRY

Harvesting stands as the most sensitive moment in raspberry cultivation (efficient organization during harvesting is vital). A significant challenge lies in the shortage of labor for harvesting, posing a threat to the production's viability. As a consequence, mechanized raspberry harvesting is increasingly being used, necessitating adaptations in cultivation methods and agricultural techniques to suit the machinery's technical specifics.

Raspberries don't ripen uniformly, prompting harvesting on multiple occasions (early mornings and late afternoons, every other day, or even more frequently, based on orchard conditions). Harvesting occurs when the fruit achieves a bright red hue (delayed harvesting results in darker fruits, offering better taste but presenting challenges in transportation and storage).



Training pickers is essential due to the fruits' sensitivity to touch and handling. The quantity picked by an individual picker hinges on various factors such as variety, weather, fruit size, packaging type, and the picker's dexterity. Harvesting is typically conducted using shallow crates or plastic containers (2-3 kg), or smaller plastic packages (125g, 150g - 200g). Stacking raspberry fruits in five or more layers is disadvantageous as the lower fruits tend to dislodge and become crushed.



Figure 10:

Raspberry fruits ripen gradually over several weeks, leading to multiple harvests. The image on the left displays young developing fruits alongside a ripe fruit and its detached stem axis from the plant. In the photo on the right, you can see plastic packaging designed for harvesting raspberries.

Experiences from Podrinje (BiH) show that, on average, a worker can harvest 25 - 30 crates in 8 hours, equivalent to about 75 kg or 8 - 11 kg per hour. Data from other countries state a range of 5 - 10 kg per hour per worker.

Prompt transportation of the fruits to cold storage or the market is crucial. Each hour of delay in refrigerating the harvested fruits reduces their storage ability by approximately 1 day.

Raspberry fruits are either sent fresh or frozen to the market post-harvest.

If we are talking about fresh fruits, they are rapidly cooled to 0°C after harvesting and promptly dispatched to the market, keeping in mind that the fruits are very sensitive and decay quickly. Fresh raspberries are stored at 0°C, maintaining a relative humidity of 90-95% with a gentle airflow to prevent it from drying out.

Raspberries undergo rapid freezing in tunnels to reach temperatures below -20°C, after which the frozen fruits are packed into plastic bags and stored for an extended duration at approximately -20°C.



Figure 11:
*Mechanized
raspberry harvesting
with trailed
harvester.*

BLUEBERRY:

Blueberry fruits are harvested multiple times over a span of 4 to 6 weeks, depending on the variety and growing conditions. Hand or machine harvesting occurs every 3 to 6 days, picking firm, ripe, and fully colored (blue) fruits. Manual harvesting is done using shallow crates for storage (if the fruits are stored for a while) or plastic packaging (for immediate market transport). Mechanized harvesting is conducted in plastic crates, later sent for storage.

Compared to raspberries and strawberries, blueberries endure transportation and storage more effectively. They can be stored for up to 25 days at approximately 0°C with high relative humidity.



Figure 12:
Blueberry fruits are often sent to the market in plastic packaging, which is then packed into cardboard boxes.

