Storage

Horticultural produce is often held in storage after being harvested. Produce may be held on a short term basis until it is sold, or longer term in an attempt to lengthen the season.

Fruits and vegetables are living tissues which carry on many biological processes after harvest. While it is desirable that some of these changes continue, most changes are undesirable. Storage attempts to slow biological changes in produce, and to minimise drying and the growth of microorganisms. Other reasons for storing produce include:

- To hold excess produce for later processing (when a plant is already processing at capacity).
- To extend the processing season.
- To maintain a year-round supply of produce.
- To hold produce back from the market when prices are low.
- To allow export of produce.

Respiration

Horticultural produce must remain alive and healthy until it is processed or eaten. The energy needed to maintain a plant's life processes comes from its food reserves (i.e. carbohydrates, proteins and fats) in a process called respiration. Oxygen from the surrounding air is used in this process and carbon dioxide is released. Some of the energy released during respiration is used for maintaining life processes, while excess energy is released in the form of heat.

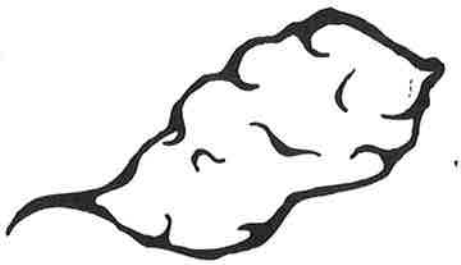
As a plant respires, and its food reserves are used up, it begins to age and lose energy value, flavour and weight. Since, therefore, respiration leads to product deterioration, it is desirable to keep the respiration rate as low as possible. Product temperature has a major influence on the rate of respiration. Rapid cooling of produce, and good temperature management during storage, acts to lower the rate of respiration and delay deterioration.

Ethylene

Ethylene gas is produced during the metabolic process in most plants, and is generally recognised as a natural aging and fruit ripening hormone. Exposure to ethylene accelerates aging for most types of produce, which is beneficial when ripening fruit. The rate of production of ethylene, and the sensitivity of products to ethylene, are temperature dependent. Therefore rapid cooling post harvest and maintenance of a constant low temperature during storage are vital, if ripening and other deterioration processes are to be delayed. The rate of ethylene production is also reduced by decreased oxygen and/or increased carbon dioxide levels surrounding produce in storage. Modifying the atmosphere in a storage facility can therefore also be used to delay deterioration.

Moisture Loss

Fresh horticultural produce gives up water to the surrounding atmosphere, and since this water cannot be regained post harvest weight loss can occur. The rate of water loss is governed by the vapour pressure difference between the product and its environment. Warm air can hold much more water vapour than cold air. If surrounding air is warm and of low relative humidity, moisture loss from produce will be great. As cool air cannot hold as much water vapour, produce will give up less moisture to cool air. Thus, maintenance of low product temperature and high humidity in the surrounding environment is essential in reducing water loss, and subsequent product shrivelling and wilting. Relative humidity in the surrounding atmosphere should be held between 90 and 95% for most perishable products.



Rot Organisms

Immature produce and produce approaching maturity have good resistance to bacterial and fungal attack. Resistance is reduced however as produce ripens and/or ages, and susceptibility to attack increases further as produce moves towards the end of its post harvest life. Physical injury and other stresses also decrease resistance to attack.
Only relatively few microorganisms cause problems for horticultural produce. Temperature affects microorganisms in the same way that it affects produce; the lower the temperature, the slower their life processes continue. Good temperature management therefore plays an important role in reducing losses from microbial attack.

Injuries

Injury and bruising of horticultural produce, as well as being visually unappealing, can cause increased ethylene production, which may accelerate aging or hasten fruit ripening. Furthermore, bruising damages the natural barriers on the surface of horticultural produce, thus increasing the potential for water loss and the entry of rot organisms. Prompt cooling and maintenance of low temperatures can slow these processes and thus reduce the impact of injuries.

Temperature Control

In general, the aims of storage are to:

- slow respiration, thereby slowing aging and deterioration
- reduce ethylene production, thereby slowing ripening and aging
- reduce product drying
- reduce microbial action
- reduce the effects of injury

Temperature control is the most important factor in delaying deterioration, and thereby extending the market life, of horticultural produce. Products should be cooled rapidly to their optimum storage temperature and held constantly at that temperature. Fluctuations in temperature may lead to water condensing on product surfaces and/or accelerated water loss. Such fluctuations can be minimised with good insulation in storage room walls, good air circulation and product stacking which allows movement of air past at least one surface of the containers in which produce is packed. .

For most products, the optimum storage temperature is the lowest temperature at which chilling or freezing injury will not occur. Symptoms of chilling injury include browning, failure to ripen, decreased resistance to microbial attack and textural changes. Temperatures above the optimum temperature range for a given fruit or vegetable will result in accelerated product deterioration and reduced storage life.

Attention should also be paid to differing optimum storage temperatures for different fruits and vegetables in the home. Some fruits and vegetables should be refrigerated (e.g. apples and lettuce), whereas others should be kept in a cool place, but not in the refrigerator (e.g. bananas).