

Pre-cooling techniques for vegetables

THE CONCEPT of pre-cooling is to remove the respiration heat from vegetables immediately after harvesting, before they are transported to market or placed in a cold store. The temperature of the vegetables is reduced quickly, in a few minutes or a few hours, so that the vegetables remain very fresh.

It is well suited to small-scale farmers, provided they can afford the facilities, and are not located too far from the market. There are several different kinds of cooling system.

Hydro-cooling

Hydro-cooling uses cold water to cool the vegetables. Hydro-cooling may be a continuous cooling process, in which the vegetables are carried by conveyor belt into a cold room. Another type is a batch cooling process, in which batches of vegetables are transported by machine into a cooling room (Fig. 1 and Fig. 2).

The vegetables are either showered with cold water, or immersed in a bath of cold water. The quantity of water used for hydro-cooling is about 400 - 600 liters per minute per square meter.



Fig. 1. Hydrocooling (batch process) of bamboo shoots.



Fig. 2. After cooling, the bamboo shoots are put in a box and kept in cool storage

Cold rooms

Cold rooms cool the vegetables with cold air rather than cold water. Cold rooms are widely used for vegetables in Asia. The air is cooled by a refrigeration unit. Optimum conditions are a wind speed of 1 - 2 meters per second. Storage boxes should be well ventilated, so all the contents of the box are in contact with the cold air.

Forced air cooling

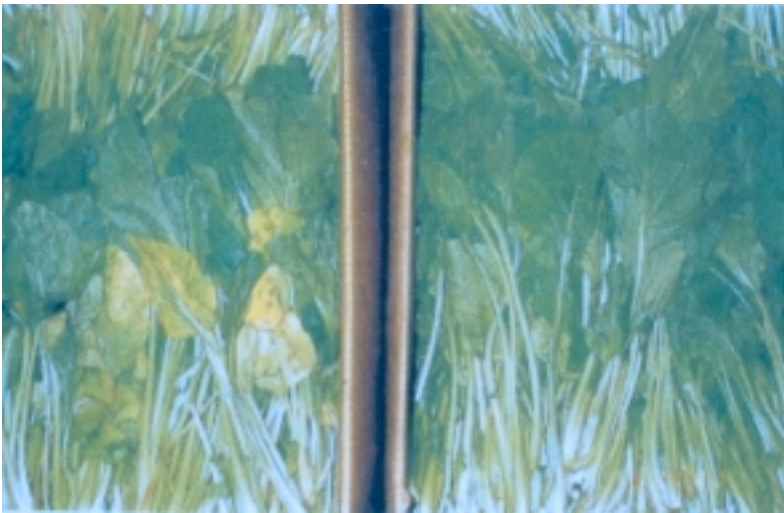
Forced air cooling is very similar to room cooling, except that the cold air is pulled by an electric fan through the stacked boxes of vegetables. Because of the increased air flow, the cooling rate is much faster than with room cooling, so that heat is taken from the vegetables in a very short time. Cooling with forced-air is also more uniform, so that vegetables in different boxes cool at much the same rate.

Two types of forced air cooling have been developed, the channel type and the cold-wall type. In the channel type, the boxes are stacked in rows on



Normal Vacuum cooled

Fig. 3. Example of vacuum cooling used for Chinese cabbage



Normal

Vacuum cooled

Fig. 4. Example of vacuum cooling used for Chinese mustard

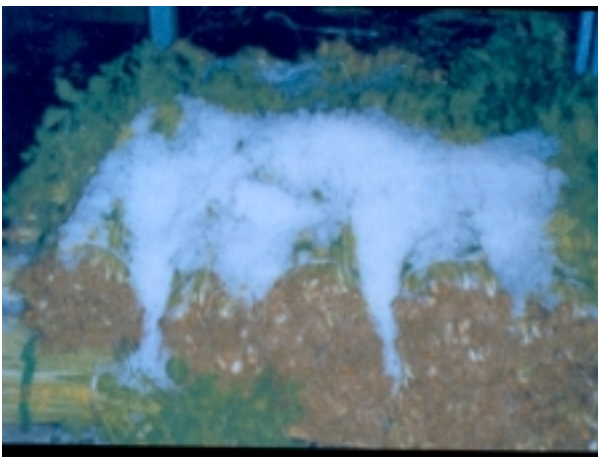


Fig. 5. Package-icing used to store celery



Fig. 6. Package-icing technique used to transport celery

pallets, to leave spaces between each box and each row. There should be an even number of pallets on either side for efficient channel cooling. The cold-wall type uses a permanent wall-mounted cooling system.

Vacuum cooling

Vacuum cooling uses an air-tight chamber. After the vegetables have been placed in the chamber, the air is removed so that the remaining air pressure is only 4.6 mm Hg. This lowers the boiling point of water, so that water on the surface of the vegetables evaporates into the air in only 10 - 30 minutes. The weight loss is about 1% for every 5 minutes. The average total weight loss is about 1.5 to 5%. Vacuum cooling is now a very popular technique in Taiwan and Japan.

Fig. 3 and Fig. 4 show two examples of vacuum cooling used for Chinese cabbage and Chinese mustard, respectively. The vegetables on the left of each photo are in normal condition, while those on the right have been treated with vacuum cooling.

Package-icing technique

In package icing, powdered ice is put in and on a packed box of vegetables, to keep the vegetables moist and at a low temperature (Fig. 5 and Fig. 6). Vegetables treated in this manner can be kept cool for a long time. It is a convenient method if growers do not have access to refrigerated transport. A plastic sheet should line the box, so the box does not absorb any water from the melted ice.

Precautions

- ❑ To be effective, the cooling chain must be continuous. It is no use cooling down vegetables immediately after harvest, if they are then transported for several hours in a hot truck to market. Once the vegetables are cooled, they must be kept cool until they reach the consumer.
- ❑ Precooling facilities can be expensive. Before growers invest in them, they should find out whether they will receive higher prices for cooled vegetables, and whether they will get a good return for their investment.