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AREA: PROFESSIONALIZZANTE: TECNOLOGIE PER LA CONSERVAZIONE E TRASFORMAZIONE

UF: PACKAGING

Packaging of Horticultural Crops

Packages are convenient units for marketing and distribution of horticultural products.

There are many different materials, sizes and shapes for packaging (more than 500 different kinds of packages are used in the US)

General properties of packages

√ **Packages should protect the products from mechanical damage.**

√ **Packages should maintain their strength and shape during long periods of storage at high RH.**

√ **Packages should allow rapid cooling.**

√ **Packages must be adaptable to high volume packaging operations (build up of pallets).**

√ **Packages should display information about the produce.**

√ **Packages should be attractive to the consumers.**

√ **Packages should be inexpensive**

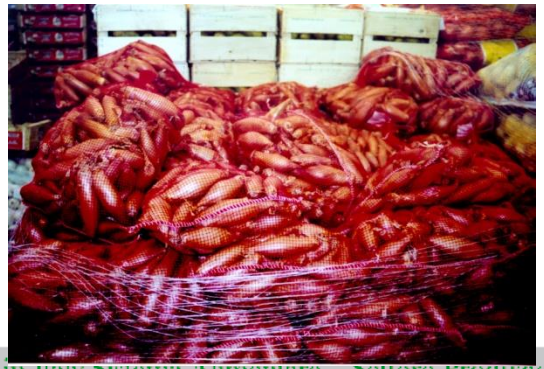
Most packages are made from: fiberboard
plastic
wood
fabric nets

Fiberboard box

Plastic box

Wood box

Fabric sacks

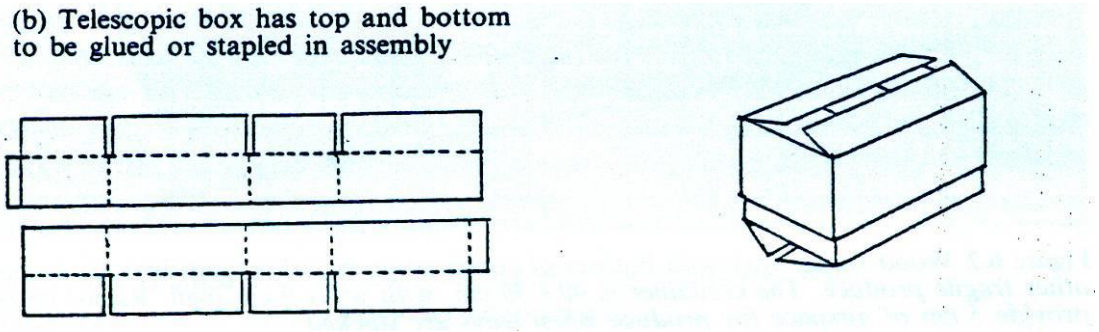


Fiberboard (cardboard) boxes

Made from solid or corrugated fiberboard.

Include either fold over (telescopic) topped boxes or open topped trays.

The boxes can be supplied flat and set up by the users.



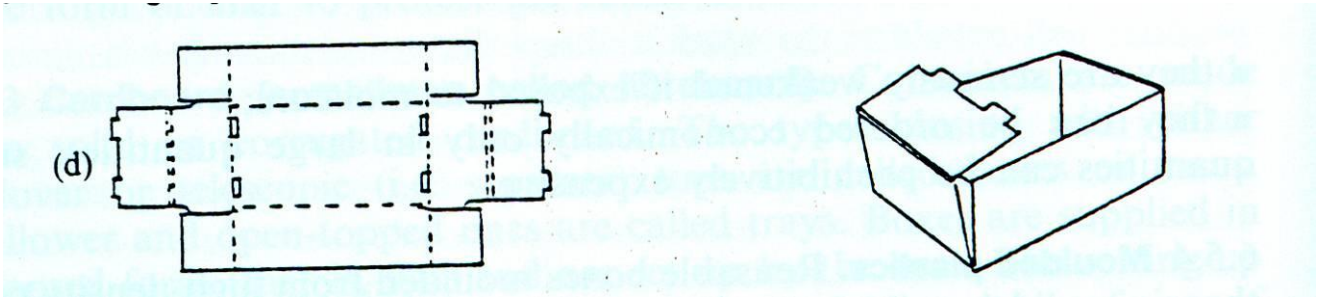


Foto pesch

Fiberboard boxes

Advantages

- Light weight
- Clean
- Easily printed
- Various sizes

Disadvantages

- Expensive, if used only once
- Easily damaged by careless handling
- Seriously weakened if exposed to moisture
- Need to be disposed

Plastic boxes

Made from high-density polyethylene.

Advantages

Very strong
Smooth
Easily cleaned
Resistance to moisture
Reusable

Disadvantages

Expensive
Require tight organization and control
Deteriorate when exposed to sunlight
Take a lot of space

WOOD BOXES

Made from veneers of various thicknesses.

Advantages

Rigid

Reusable

Stack well on trucks

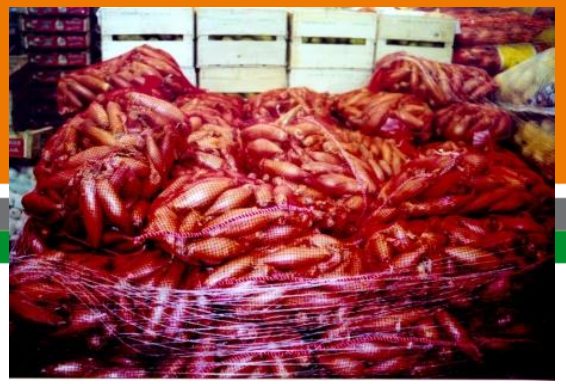
Disadvantages

Difficult to clean

Expensive

Heavy

Often have sharp edges or splinters



FABRIC SACKS

Made from polypropylene or polyethylene fibers.

Usually used with less easily damaged produce such as potatoes and onion.

Advantages

Inexpensive

Various capacities

Disadvantages

Lack rigidity, and handling, especially dropping, can damage the produce

Often too large for careful handling

Difficult to stack on pallets

Package requirements

- √ Protection from injuries.
- √ Temperature management.
- √ Protection from water loss.
- √ Facilitating special treatments.
- √ Compatibility with handling systems.
- √ Economic considerations.
- √ Display information about the product

Package requirements

Protection from injuries.
Temperature management.
Protection from water loss.
Compatibility with handling systems.
Economic considerations.
Display information about the product.

Protection from injuries

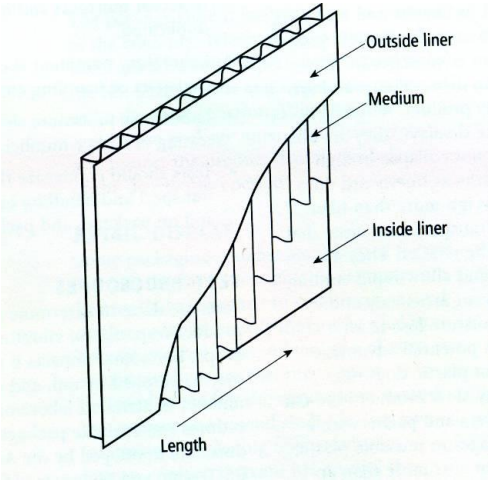
Impact (shock) bruises – are caused by dropping the product onto a hard surface.

Bruises could occur either during dropping the product into the box or by rough handling by hand or machinery.

To reduce impact bruising, it is important:

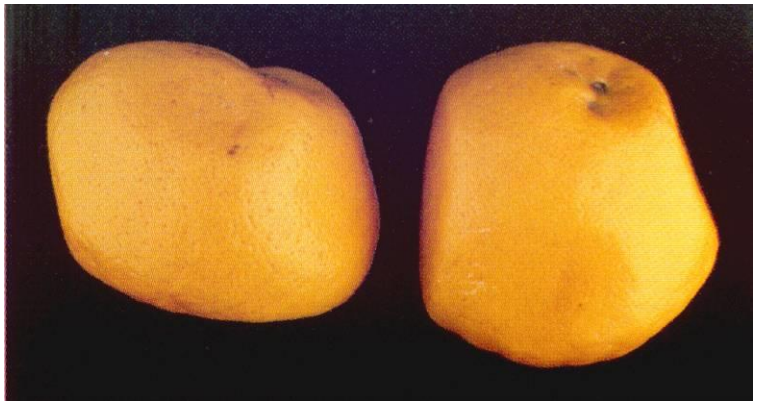
1. **To reduce drop height during volume filling.**
2. **Maintain careful handling during the marketing chain.**

Corrugated fiberboard boxes can absorb some shocks by permanently compressing



Compression (squeezing) bruises – are caused by overfilling boxes or by allowing too much product depth.

Overfilled fiberboard boxes become week, and deform, and the weight of the packages above may cause compression bruises.



Soft commodities require shallow packing depths to prevent compression of the produce.

One layer packages of tomatoes

FOTO MELE/PESCHE NETTARIN

Vibration (shaking) damage – some products are damaged when they move inside the box during transit.

There are various techniques to pack the product so that it is immobilized in the box to prevent vibration damage:

1. Packing in plastic bags.
2. Adding supplemental materials: trays, cups, pads, etc.
3. Tight-fill packing: padding that fills the free volume of the box.

Using a plastic bag to prevent vibration damage in pears

A simple designed-box to prevent movement of mango

Pads to prevent vibration damage in mango

Cupped trays for packing….

Cupped trays for packing

Using filling materials to prevent vibration damage in melons

Package requirements

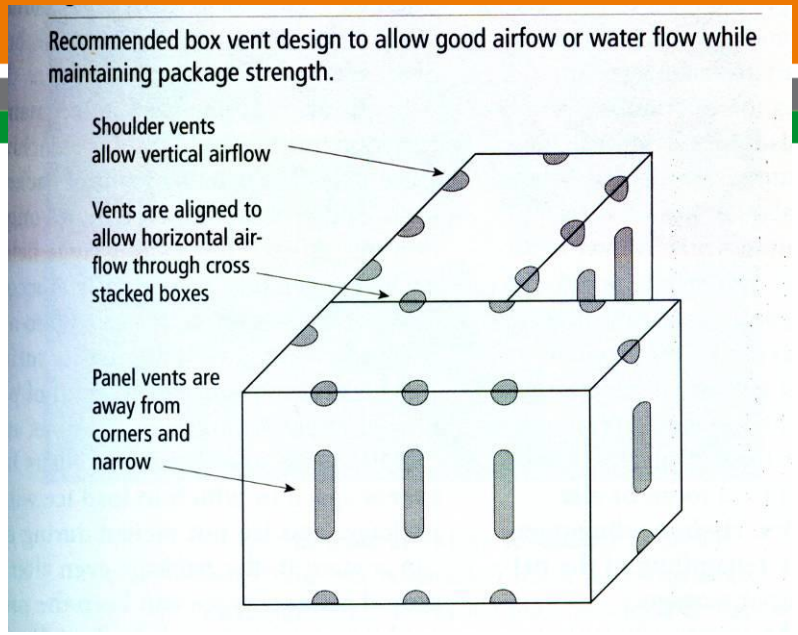
Protection from injuries.
Temperature management.
Protection from water loss.
Compatibility with handling systems.
Economic considerations.
Display information about the product.

Temperature management

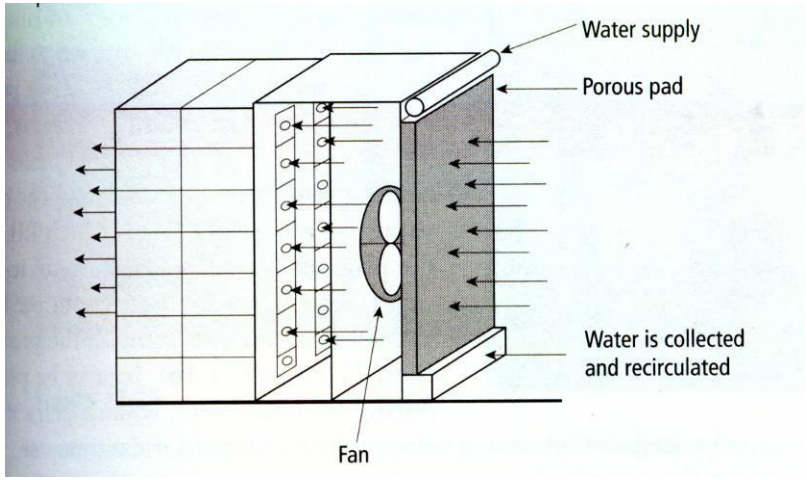
Packages must accommodate the temperatures requirements of the product!

Good temperature management depends on good contact between the product in the package and the environment:

1. **There should be sufficient air flow near package surface.**
2. **Ventilation is needed for forced-air cooling (increasing the ventilation area speeds heat exchange).**



Corrugated fiberboard boxes with vertical ventilation slots



Forced-air cooling and movement of air through the ventilation areas

For corrugated fiberboard boxes: 5% venting area of side panels allows rapid cooling without overly weakening the package.

Most of the strength in corrugated fiberboard boxes is built near the corners. Therefore, it is recommended that the ventilation slots should be located at least 5 cm away from the edges and oriented vertically to minimize strength loss.

Ventilated packages used for forced-air cooling are also suitable for "in-box" room ripening with ethylene!

Maintaining low temperatures during air craft using insulation materials

Package requirements

Protection from injuries.
Temperature management.
Protection from water loss.
Compatibility with handling systems.
Economic considerations.
Display information about the product.

Protection from water loss

Water loss occurs because of a water vapor pressure difference between the product (which is usually near saturation, 100% RH) and the environment.

Wood and fiberboard absorb water whereas plastic boxes do not!

Therefore, plastic boxes allow to maintain a saturated atmosphere within the package and reduce water loss.

The inside surface of corrugated fiberboard boxes may be coated with polyethylene wax emulsions to restrict moisture loss.

In addition, plastic liner bags or sleeves (curtains) may provide an external barrier to movement of water vapor from the product to the environment.

Package requirements

Protection from injuries.
Temperature management.
Protection from water loss.
Compatibility with handling systems.
Economic considerations.
Display information about the product.

Compatibility with handling systems

Most packages are hand lifted at some points of the marketing chain, so package weight must be limited.

A few commodities, like watermelons, are picked and marketed in pallet bins designed only for mechanical lifts.

Bulk bins designed for mechanical lifting

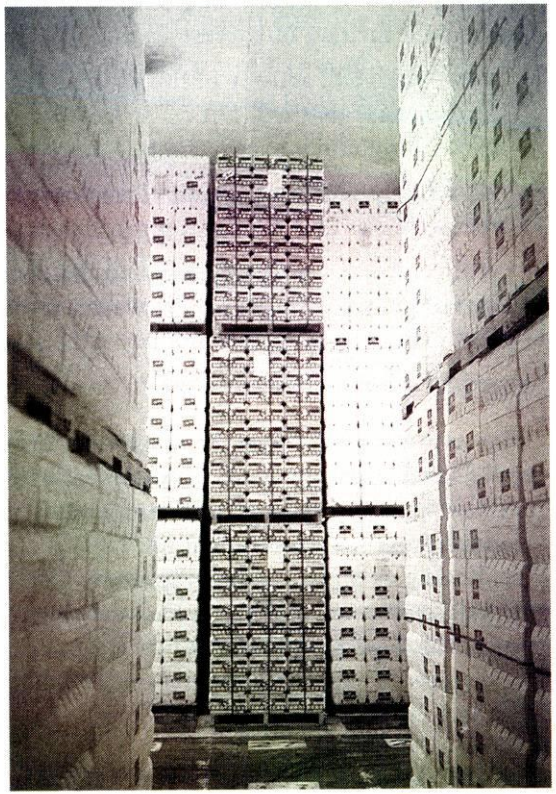
The packages should be sized to fill a pallet, that is usually 1.2 m x 1 m.

Table 10.1. Horizontal box dimensions for standard-sized pallets

Boxes per layer	Nominal outside box dimensions for 48" × 40" pallet* length × width (in)	Nominal outside box dimensions for 1,000 × 1,200 mm pallet length × width (mm)
4	24 × 12	500 × 300
5	24 × 16	600 × 400
6	20 × 16	500 × 400
8	20 × 12	500 × 300
9	19 × 13.3	400 × 333

Compression bruises may also occur if a box is not strong enough to support the weight of the boxes on top of it (It's not recommended to stock more then two pallets on top each other).

Interior view of a table grape cold storage.



Pallets in a cold storage room of grapes

Compression damage may also occur because of unstable stowage of boxes during transit

Figure 8.1 *Unstable stowage leads to collapse of the stack and crushed produce*
Photo: Courtesy Winban, St. Lucia, West Indies

Root, bulb, and tuber crops, are usually packed in large fabric sacks, which are inexpensive but provide little protection from mechanical damage.

Packing facilities

The chosen package must be compatible with other packing equipment (modifying the equipment is expensive).

A package used for field packing must be compatible with field conditions:

If the package might be exposed to rain – it's better to use plastic moisture-resistant boxes.

If packages are placed on the ground they may collect soil and contaminate neighboring boxes. In this case, it's better to use closed-top packages.

Handling

Each time a package is handled, the box and it's content are subject to damage.

Manual handling and palletizing is particularly damaging, since the workers usually drop heavy boxes into their position to prevent back pains. Therefore, filled boxes should not weigh more than 15-20 kg.

Retail display

Some packages are designed for use in retail display. For example, berries packed in small baskets, carrots in consumer size bags, mandarins in fabric nets, etc.

Attached booklets with peeling instructions

Disposal

In recent years, package disposal became a serious issue in Europe and USA.

Non-waxed fiberboard boxes can be recycled.

Waxed fiberboard boxes should be recycled separately.

Package requirements

Protection from injuries.
Temperature management.
Protection from water loss.
Compatibility with handling systems.
Economic considerations.
Display information about the product.

Economic considerations

Economic considerations of choosing a package type for a given commodity are complicated and may depend on various circumstances, including:

- Direct cost of the package

- Effects of the package on reducing loss

- Disposal costs

Overall, marketable experience shows that good produce well packed has an advantage over produce poorly packed, and the profits from it can cover the investment.

Package requirements

Protection from injuries.
Temperature management.
Protection from water loss.
Compatibility with handling systems.
Economic considerations.
Display information about the product.

The package must display all relevant information for the costumer:

- Place (country, farm) of production
- Date of packaging
- Name of variety
- Weight, size and quantity of the produce
- Postharvest applications of chemicals and waxes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Size
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Diameter/Weight
Diametre/Poids
Durchmesser/Gewicht
S 60-80 mm
M 70-90 mm
M2 135-155 gr.
M 150-180 gr.
L 180-220 gr.
L 80-100mm
EL 90-110mm