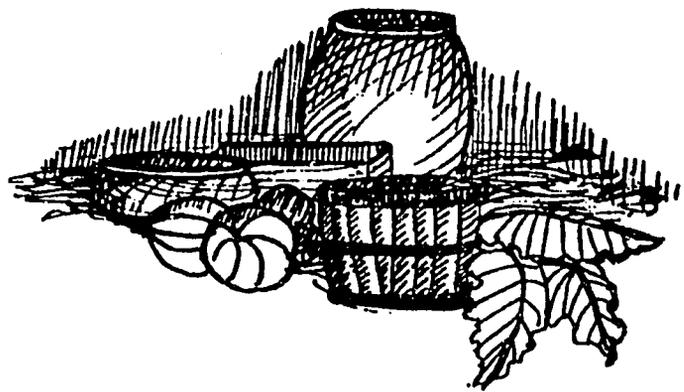


PL. F. 100 28  
100-09702

932 000 9/67 11012



# Fresh Produce Handling and Distribution

Rene Guillou

a **VITA** publication

# **Fresh Produce Handling and Distribution**

**RENE GUILLOU**

Illustration by Christine Vaugh  
Revised by Curtis E. McDaniel

VOLUNTEERS IN TECHNICAL ASSISTANCE, INC.  
3706 Rhode Island Avenue  
Mt. Rainier, Maryland 20822  
U.S.A.

## 1. Introduction

Produce, fresh fruits and vegetables, can be very valuable to a community both as food for its people and as a cash crop for its producers. Careful work goes into growing and harvesting the produce. It must be handled with equal care after harvesting so that its value will not be lost.

Chances of maintaining good quality in fresh fruits and vegetables during storage, handling and distribution are increased if the initial quality is high.

Ship fresh fruits and vegetables that are brightly colored and free of defects and bruises. Ship leafy greens that have firm, crisp leaves and no sign of wilt.

Fresh fruits and vegetables can only be stored for a short length of time before quality deteriorates.

Shipping and distribution should be done soon after harvesting to insure quality produce reaches the market. Experiments with local varieties can be conducted to determine the length of time quality will remain good after harvesting.

Generally, maintaining moisture level in produce and lowering its temperature will increase time that the quality will remain good.

The way produce is handled in a community may have been learned from years of trial and error. This trial and error process may now be forgotten, but the reasons for traditional methods should be understood. Possible changes should be tested before they are out into practice. This is the only way to be sure that newer methods are really better than traditional ones. However, the following suggestions may be helpful in solving problems connected with traditional methods or in developing new methods for new crops or conditions.

## 2. Ripening Characteristics

Different kinds of produce are handled in varying stages of ripeness.

Fruit should be sorted and only what is firm and sound should be shipped. This usually requires fruit to be harvested green or before peak ripening stage. Most fruit harvested green or before peak ripening will ripen at room temperature with acceptable quality.

Some fruits, bananas and pears, for example, reach best quality if they are harvested before ripening and allowed to ripen later. This means that they can be handled and transported before they are ripe and while they are still quite hard. Once they are ripe, though, they are quite fragile.

Peaches and tomatoes are examples of products which are easily injured and difficult to handle and transport if fully ripe when harvested. However, if harvested when less than fully ripe, these products are less fragile and subsequent ripening is satisfactory, even if not quite equal to ripening before harvest.

There is a third large group, including berries, grapes and most green vegetables, in which there is no true ripening after harvest, and which must therefore be allowed to reach a satisfactory condition before harvest.

Tomatoes can be harvested in various stages of ripening after maturity. Ripe tomatoes are easily injured in shipping and will only keep for about three days unless refrigerated to 40-50°F (4-10°C). Mature green tomatoes are firm and less likely to be injured in shipping. Green tomatoes will ripen at room temperature.

## 3. Cooling Requirements

All produce will keep better at cool temperatures. When produce is harvested, it is usually too warm for storage and should be cooled. Leaving harvested produce in the sun, even for a short time, should be avoided. Harvesting early in the day or exposing harvested produce to night air is usually desirable in areas where nights are much cooler than days.

In general, produce should be kept in as cool a place as is available. It should also be protected from too much air movement if the air is dry, because this can cause the produce to wilt. But ventilation should not be too restricted because continuing ripening processes produce heat rapidly enough to cause serious overheating in some products.

**COMMODITIES SUSCEPTIBLE TO COLD INJURY  
WHEN STORED AT ONLY MODERATELY LOW TEMPERATURES.  
CRITICAL TEMPERATURES AND SYMPTOMS OF INJURY.**

(Reprinted from US Dept. of Agriculture Handbook #66)

COMMODITY	APPROX. LOWEST SAFE TEMPERATURE °F	°C	CHARACTER OF INJURY WHEN STORED BETWEEN 32°F AND SAFE TEMPERATURE
Apples - certain varieties	34-36	1-2	Internal browning, soggy breakdown.
Avocados	45	7	Internal browning.
Bananas, green or ripe	56	13	Dull color when ripened.
Beans (snap)	45-50	7-10	Pitting increasing on removal, russetting on removal.
Cranberries	34	1	Low-temperature breakdown.
Cucumbers	45	7	Pitting, water-soaked spots, decay.
Eggplants	45	7	Pitting or bronzing, increasing on removal.
Grapefruit	45	7	Scald, pitting, watery breakdown, internal browning.
Lemons	55-58	13-14	Internal discoloration, pitting.
Limes	45	7	Pitting.
Manoes	50	10	Internal discoloration.
Melons:			
Cantaloups	(1)		Pitting, surface decay.
Honey Dew	40-50	4-10	Pitting, surface decay.
Casaba	40-50	4-10	Pitting, surface decay.
Crenshaw & Persian	40-50	4-10	Pitting, surface decay.
Watermelons	36	2	Pitting, objectionable flavor.
Okra	40	4	Discoloration, water-soaked areas, pitting, decay.
Olives, fresh	45	7	Internal browning.
Oranges, California	35-37	2-3	Rind disorders.
Papayas	45	7	Breakdown.
Peppers, sweet	45	7	Pitting, discoloration near calyx.
Pineapples	(2)		Dull green when ripened.
Potatoes, Chippewa & Sebago	40	4	Mahogany browning.
Squash, winter	50-55	10-12	Decay.
Sweetpotatoes	55	12	Decay, pitting, internal discoloration.
Tomatoes:			
Ripe	50	10	Breakdown.
Mature-green	55	12	Poor color when ripe; tendency to decay rapidly.

- (1) Cantaloups deteriorate extremely rapidly. Under the most favorable storage conditions (40-50°F) ripe melons will not keep more than a few days. Half-ripe melons can be kept a week or two.
- (2) Pineapples decay rapidly and are not adapted to long storage. Fully ripe ones should be stored at 40-50°F and can be kept for two to four weeks. Mature green ones can ripen slowly at 50-60°F and kept two to three weeks.

In the tropics, molds and rot caused by high humidity (moist air) may be more of a problem than wilting. In this case, free natural air circulation may be best.

The amount of moisture and degree of temperature needed to maintain quality varies with different fruits and vegetables.

Green, leafy vegetables need cold, moist air to retain their crispness, otherwise their quality deteriorates rapidly.

Most perishable fruits and vegetables keep longer in a temperature of 40-50°F (4-10°C), but certain varieties of apples and of vegetables, such as potatoes, onions, hard-rind squash and eggplants keep well in a cool, dark place. A few fruits and vegetables can be stored and shipped successfully at room temperature.

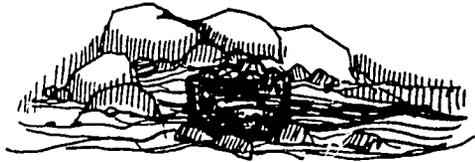
Many products keep best at temperatures just above freezing, but others, especially some tropical species, may be injured by low temperatures. When it is not known how such a product will react to a low temperature, it is safest not to cool it below 60°F (16°C).

Where markets are close and refrigeration is not available, produce can be harvested in the cool of evening and transported to market during the night. Most produce can be distributed this way, even those that are moisture sensitive or require full ripening for good quality.

Elaborate storage procedures are often not feasible and may be of little value with products for early use or local consumption.

Where winters are cold some products are stored with excellent results in various containers or cellars which have been developed for local conditions.

If possible and if justified for distant shipment or longer storage, produce can be cooled by packing it in ice, by showering it with cold water or by immersing it in running cold water. To avoid introducing or spreading decay, the water must be fresh and pure or must contain disinfectants.



Expert advice, available through VITA, should be sought on the use of disinfectants because there is a narrow margin between concentrations that control decay and those that injure the product or leave poisonous residues.

When refrigeration is available, it is safe and effective to cool produce by circulating refrigerated air about containers or through them. When the produce is cool, air movement should be sharply reduced to avoid wilting.



The life of most products can be much extended by refrigerated storage and some products can be kept for long periods, though whether this is feasible or not depends on the local situation. Storage and ripening characteristics and benefits possible from refrigerated storage are given in references 1 and 2.

Berries and cherries are moisture sensitive and need cool, moist air to maintain quality.

Citrus fruits can be shipped and stored at room temperature.

Vacuum cooling, in which produce is cooled in a vacuum chamber by evaporation of part of its moisture, requires costly equipment. It is feasible only where a substantial volume of leafy vegetables can be harvested over a long season and shipped profitably to distant markets. Most equipment is built to order in areas where the process is used. (See reference 3.)

#### 4. Protection Against Mechanical Injury

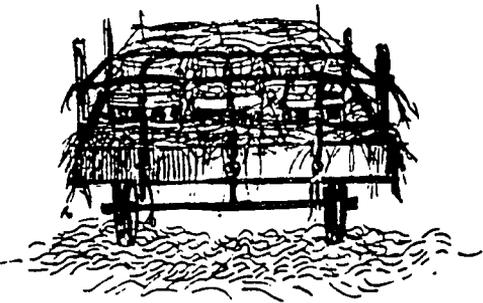
Handle fresh fruit and vegetables carefully to prevent injury. Fruits are fragile and need special handling to keep from being crushed or bruised. The soft tissue permits entrance of spoilage organisms that quickly cause loss of quality. Injured fruit will contaminate sound, firm fruit.

Bruising may be serious in delicate produce if handling or transportation is rough. Even when bruising is not immediately noticeable, it may markedly speed up ripening, wilting and decay. Bruising can result from

impacts, chafing, vibration or too much pressing. Products vary widely in their susceptibility to bruising. It is sometimes impossible to determine the cause of a bruise by inspecting it. However, damage prevention obviously depends on finding out where and how the damage occurs. Much can be learned from careful observation of packing, handling and transportation. Attempts to re-enact an observed injury by pressing, dropping or chafing a few articles or by transporting them loose in a box, may help in determining the cause.

Packing which protects against one type of injury may cause another type. Packing produce loosely in open shallow containers prevents excessive pressure, but may cause injury by impacts, chafing or vibration. On the other hand, snug packing and covers which hold produce firmly in place can stop chafing and vibration but may produce pressure bruises. The best balance between looseness and firmness depends on the particular produce and its stage of ripeness. It is best determined by trial and error. Impact bruising can be controlled by more careful handling and padding, preferably with locally available materials. Padding also helps to distribute pressure in a tight pack, reducing pressure bruising.

Vehicles in which delicate produce is transported should obviously be as free as possible from impacts and vibration, but, in practice, often whatever vehicles are available must be used.



If there is a choice in positions in a vehicle the best ride is low down and midway between the axles. To reduce vibration and impacts, containers should be loaded snugly and tied down tightly. A layer of grass on the bottom of the cart will help to reduce damage.

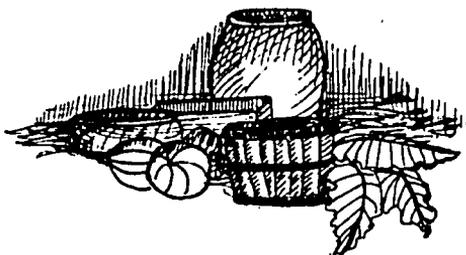
Sun shining on a load of produce in an open vehicle is harmful, as is dry air blowing through the load. Therefore, any kind of

covering is helpful: over the cart, to keep out the sun; over the containers, to protect the produce from the dry air.

If refrigerated vehicles are available, produce should be cooled before it is loaded. Vehicle refrigeration is usually designed to keep the load cool rather than to cool it; there is seldom enough air movement within the load for cooling.

## 5. Fumigation for insect control

Fruit flies or other insects in fresh produce may be controlled by fumigation in some situations. Direction by someone experienced in this work is essential, however, to insure safety to personnel, efficacy of the treatment, and avoidance of injury to the product. Special licenses for fumigation are required in many countries. Characteristics of fumigants and their use with various products are discussed in reference #4.



### Additional References

- 1 US Department of Agriculture Handbook #66, "The Commercial Storage of Fruits, Vegetables and Florist and Nursery Stocks," Superintendent of Documents, Government Printing Office, Washington, D.C. 20401.
- 2 "Recommended Conditions for Cold Storage of Perishable Produce", 2nd edition, 1967. (In English and French on facing pages) Institut International du Froid, 177, Boulevard Malasherbes, 75-Paris (17e), France. Price: F.12 or US\$2.50.
- 3 Coolers for Fruits and Vegetables. Bulletin 773, 1960. pp10-12. University of California, Agricultural Experiment Station, Davis, California 95616. No charge for single copies.
- 4 Manual of Fumigation for Insect Control. By H.A.U. Monro. FAO Agricultural Studies No. 56. Food and Agriculture Organization of the United Nations, Rome, 1964. Available from Columbia Univ. Press, Intl. Documents Svc., 2960 Broadway, N.Y., NY 10027, or sales agents for FAO publications in principal cities of most member countries. Price \$3 or 15s.

# VITA Publications

VITA's manuals reflect the organization's emphasis on designing, developing and distributing village and community level technologies which are appropriate for use in developing countries. At the same time, these technologies have application wherever people are interested in protecting resources and in doing things themselves. VITA makes this technology available through its Publications Service, which distributes material worldwide.

VITA's Publications Service seeks to print and distribute manuals in a form which can be used easily by the extension agent in a field situation or by the do-it-yourselfer at home. The material is offered at low prices, in clear, often fully illustrated format and in non-technical language.

## Announcing...

SMALL FARM GRAIN STORAGE (1976) 575 pages English

A complete practical overview of small farm grain storage questions for use by development workers and others concerned with small-scale grain production. Includes plans for grain dryer and storage facilities, instructions for rodent and insect control.

FRESHWATER FISH POND CULTURE AND MANAGEMENT (1976) 200 pages English

A guide to planning, construction and maintaining smaller-scale fish pond operations. Includes information on selecting warm water fish, choosing drainage systems, treating fish for disease, fertilizing ponds, and so on.

REFORESTATION IN ARID LANDS (forthcoming) English

Provides guidelines for planning and carrying out a reforestation project -- from nursery to planting site. Includes information on planting, transplanting and transporting. Extensive appendices present a detailed look at trees, soil, climate, and reforestation activities in sub-Saharan West Africa.

USING WATER RESOURCES (forthcoming) 150 pages English

Available for the first time as a separate offering in response to user demand, this volume is an excerpt from VITA's ever popular, highly touted VILLAGE TECHNOLOGY HANDBOOK (also included on this list). USING WATER RESOURCES contains information and plans for tubewells and dug wells, water lifting, pumps, water storing and purifying, and so on.

HANDLOOM CONSTRUCTION (forthcoming) English  
Contains detailed, fully illustrated step-by-step construction procedures for three types of handloom.

RABBIT RAISING (forthcoming) English

A complete guide for the rabbit raiser. Contains guidelines for breeding rabbits, treating for disease, feeding stock, building hutches, keeping records, and tanning skins.

## ...of continuing interest

VILLAGE TECHNOLOGY HANDBOOK (1970) 350 pages English, French, Spanish

VITA's helpful guide to alternative technologies. Provides detailed technical plans in the areas of water resources, tools for agriculture, construction and sanitation, among others.

AUTOMOTIVE OPERATION AND MAINTENANCE (1975) 202 pages English

A manual for drivers who deal with poor roads and poor service facilities.

SMOKING FISH IN A CARDBOARD SMOKEHOUSE (1966) 12 pages English, French, Spanish

HOW TO SALT FISH (1966) 10 pages English, Spanish

SOLAR COOKER CONSTRUCTION MANUAL (1967) 25 pages English, Spanish

FRESH PRODUCE HANDLING AND DISTRIBUTION (1968) 10 pages English

Excerpted from the VILLAGE TECHNOLOGY HANDBOOK

GROUNDNUT (PEANUT) HULLER (revised 1977) 8 pages English, French

HOW TO PERFORM AN AGRICULTURAL EXPERIMENT (1971) 30 pages English, French

- MAKING BUILDING BLOCKS WITH THE CINVA-RAM BLOCK PRESS (1966)** 30 pages  
English, French, Spanish
- SMALL SCALE MANUFACTURE OF BURNED BUILDING BRICK (1966)** 24 pages  
English, French, Spanish, Portuguese
- DESIGN GUIDE FOR LIGHT AIRCRAFT AIRPORT (1970)** 50 pages English
- WATERPROOFING SOIL CONSTRUCTION (1973)** 15 pages English, French  
A helpful guide to using local tree and other materials to provide substances for waterproofing constructions made of earth.
- HEALTH RECORDS SYSTEM (1971)** 25 pages English
- BANDAGES IMPREGNATED WITH PLASTER OF PARIS (1971)** 22 pages English
- LOW COST DEVELOPMENT OF SMALL WATER POWER SITES (1967)** 50 pages  
English, French, Spanish
- HYDRAULIC RAM FOR VILLAGE USE (1970)** 15 pages  
English, French, Spanish
- LOW COST WINDMILL FOR DEVELOPING NATIONS (1970)** 45 pages English, French
- DESIGN MANUAL FOR WATER WHEELS (1975)** 80 pages English
- HANDPUMPS FOR VILLAGE WELLS (1975)** 15 pages English
- BAT CONTROL (1963)** 8 pages English
- CHALK STICK MAKING (1969)** 25 pages  
English, French
- PLAYGROUND MANUAL (1969)** 40 pages English  
A good selection of playground equipment which can be made from local and imported materials.
- A GUIDE TO MOBILIZING TECHNICAL ASSISTANCE VOLUNTEERS (1975)** 75 pages English, Portuguese  
An in-depth look at a VITA-type operation.
- SIMPLE FURNITURE DESIGN (1975)** 20 pages English

**Highly recommended  
and available from VITA...**

**APPROPRIATE TECHNOLOGY SOURCEBOOK (1976)**  
by Ken Darrow and Rick Pam, Volunteers in Asia, Inc. 305 pages English

A guide to practical plans and books for village and small community technology. Contains reviews of 375 selected U.S. and international publications on alternative sources of energy, shop tools, agriculture, low-cost housing, water supply and so on. Includes addresses and prices for entries.

**LILIK BUK, A RURAL DEVELOPMENT HANDBOOK CATALOGUE (1977)** 270 pages English  
Prepared for use by community level leaders and others interested in village self-help action in Papua, New Guinea, this valuable handbook provides plans and leads to information on subjects of worldwide importance; for example, village industry and crafts, fish culture, animal husbandry, water resource development, visual aids for community education, soil management; building and road construction.

**For information on availability  
and prices, contact:**

**VITA Publications Service  
3706 Rhode Island Ave.  
Mt. Rainier, Maryland 20822  
USA**