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## Pepper Production Guide for Florida: Harvesting and Handling<sup>1</sup>

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Severe postharvest losses may be incurred from bacterial soft rot or stem-end decay on peppers. There are no easy answers to this problem, thus management of all harvesting and handling practices must be geared to minimize the risk of fruit inoculation and the spread of soft rot bacteria, *Erwinia carotovora*.

### Harvesting

The readiness of peppers for harvest is judged by fruit size, color, and firmness (Figure 1). Immature peppers have thin walls and soft walls. Mature green peppers have thicker walls, shiny dark-green color, and firm walls. Peppers continue to increase in size and wall thickness while green in color, and prices are generally higher for the larger sizes. There usually is a strong market for red-ripe peppers, but there is little demand for turning and partly red fruit. Red-ripe peppers have obtained maximum size and wall thickness, and they contain 50 percent more sugars and 10 times more vitamin A than green peppers.

Multiple harvests of peppers are done by hand. Pickers break the fruit from the plant with stems

attached to the fruit. Pickers should be encouraged to harvest peppers with intact or nearly intact stems. Peppers with intact stems are more resistant to bacterial soft rot than those with jagged, torn, or no stems.

Pickers collect fruits in harvest containers which are later dumped into pallet bins for transport to the packinghouse, or fruits are placed on conveyors for transfer to the packing line of the harvest aid. Peppers should be handled carefully to minimize



Figure 1. High quality pepper fruits ready for harvest.

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physical damage. Every puncture, abrasion, bruise, etc., is a potential site for decay to develop. Pickers should not be allowed to put decaying fruit into harvest containers or on harvest aid conveyors. Decaying fruit serve as a source of inoculum to infect otherwise healthy fruit. Cleaning and disinfecting harvest containers daily or lining them with clean paper also will help minimize the spread of decay.

## Packing

Peppers can be field packed or shed packed. Field packing offers several advantages over a packinghouse operation:

- 1) it involves less capital investment;
- 2) culled fruits are left in the field, which eliminates the time and energy cost associated with transporting them from the field;
- 3) the product is handled less, which minimizes damage and maximizes marketable yields; and
- 4) harvesting and packing are closely coordinated.

Pallet bins arriving at the packinghouse should be stacked in the shade to prevent unnecessary heating of the fruit. Overfilled bins will result in pepper crushing and bruising when they are stacked. Harvest operations need to be closely coordinated with packing to minimize the delay between harvest and packing. An overnight delay resulted in a 23 percent loss in marketable fruit inoculated with bacterial soft rot.

Handling steps generally include dumping the fruit, washing, drying, sizing, grading, and packing. Two people should be stationed to remove decaying and damaged fruits as they are elevated from the dump to the grading belt. This area should be well-lighted to make this important job easier. Removal of decaying fruit at this point minimizes contamination of the cleaning brushes and other contact surfaces further down the grading line. All surfaces that come into contact with the fruit, from the dump onward, should be cleaned and disinfested daily. This disinfesting serves two useful decay-preventing purposes: 1) it prevents the accumulation of sand and

other abrading particles on contact surfaces; and 2) it prevents buildup of inoculum on contact surfaces.

Usually, peppers should be washed to remove dirt. Under conditions when bacterial soft rot has been a problem, it is suggested that fruit be spray-washed with water containing 75 to 100 ppm free chlorine. Water dump tanks are not generally recommended for peppers because water may enter the fruit around the calyx or occasionally through the blossom scar. Chlorination of the wash water is relatively inexpensive and serves to prevent the buildup of inoculum on the rollers, brushes, and conveyors farther along the packing line. For more information about chlorination, see Vegetable Crops Fact Sheet VC-1, "Water Chlorination for Vegetable Packinghouses."

Following washing, excess water is removed by a series of sponge rollers and fruits are mechanically sized. Sized fruits are then sorted by hand for color and defects. Depending on market conditions, packers may have as many as 27 different color, size, and grade combinations. Sorting and grading after sizing may improve the quality of the packed peppers because graders are assigned a specific size of fruit and more graders can be added to the high volume sizes. Peppers are generally sold by size (count). The terms "small," "medium," "large," and "jumbo" may be used to describe peppers, but there are no standard definitions for these terms and counts may vary considerably by production area and season. Peppers are jumble-packed into cartons, either by hand or mechanically. Closing the shipping cartons with straps or glue rather than staples can reduce fruit damage.

## Grades

Grade standards describe the quality requirements for each grade of a commodity, and when they are used, give the industry a common language for buying and selling. United States standards for mature, green, sweet peppers specify three grades: U.S. Fancy, U.S. No.1, and U.S. No. 2. Fancy peppers must have a minimum diameter of 3 inches and a minimum length of 3½ inches. U.S. No. 1 peppers must have a minimum diameter and length of 2½ inches, unless otherwise specified. U.S. No. 2 grade has no size requirements. If at least 90 percent

of the peppers show any amount of a shade of red, they may be designated as U.S. Fancy Red, U.S. No. 1 Red, or U.S. No. 2 Red, provided they meet the other requirements of the grade. Lots that fall in between in terms of color may be designated U.S. Fancy Mixed Color, U.S. No. 1 Mixed Color, or U.S. No. 2 Mixed Color, provided they meet the other requirements of the grade. A tolerance of 10 percent is allowed for variations incident to proper grading and handling provided that not more than five percent constitutes serious damage, including not more than two percent for decay.

Shipping point inspection for grade certification is available for most commodities. A copy of the grade standards can be obtained through your County Extension Office.

## Containers

The 1 1/9 bushel waxed fiberboard carton is the most common container in use. More efficient containers are available. As part of a national trade organization effort to standardize shipping containers for fresh fruits and vegetables, shippers are urged to use a container that utilizes 90 to 100 percent of the 48-by-40-inch pallet or slipsheet surface and facilitates unitization.

A standard container with outside dimensions of 19.7 inches long, 11.8 inches wide, and 11.8 inches deep has been tested and is an excellent substitute for the 1 1/9 bushel carton. This carton column stacks eight per layer and utilizes 96 percent of the 48-by-40-inch pallet surface. For those needing a standard container that can be cross-stacked during palletization, a carton with outside dimensions of 19.7 inches long, 13.1 inches wide, and 10.2 inches deep may be a suitable alternative. This carton has a stacking pattern of seven per layer, and every third or fourth layer may be turned 180° to “tie” the stack. This container also utilized 96 percent of the pallet surface.

## Labeling

The inadequate product identification information currently found on shipping containers causes many problems in the food distribution system. This is particularly true for peppers, which are shipped in a

carton that is often used for cucumbers and occasionally for acorn squash.

It is recommended that 65 percent of the space of at least two sides (preferably four sides) of all shipping containers be used for product identification information (commodity, size or count, cultivar, weight, and grade). The remaining 35 percent should be used for brand name, shipper, and address. For the containers described above, it is suggested that the minimum height of lettering for size/count, cultivar, and commodity be 1 inch; for origin, weight, and grade, a minimum letter size of one-half inch is suggested.

## Cooling

Prompt, thorough cooling of peppers, soon after harvest, maximizes shelf-life and minimizes deterioration by slowing respiration, reducing water loss, inhibiting color changes, and retarding decay. Specifically, pre-transit cooling to 50°F by an appropriate cooling method, such as room, forced-air, or vacuum cooling, retarded bacterial soft rot when compared to noncooled peppers.

Forced-air cooling and vacuum cooling are the most effective cooling methods for peppers. Portability of vacuum cooling equipment may make it more widely available to Florida shippers. Wetting peppers prior to vacuum cooling enhanced removal of heat during the cooling cycle.

## Shipping and Storage

Questions often arise about postharvest treatments to “ripen” green sweet peppers. The purpose of these treatments would be to hasten a uniform red color development as is done for mature green tomatoes. Although considerable research has been done, no commercially acceptable postharvest “degreening” treatment has been developed.

The optimum shipping and storage temperature for peppers is 50° F. Above this temperature, color development and decay may occur, and below this temperature, chilling injury may occur, particularly during long transit or storage periods (14 days). Chilling injury symptoms on pepper include “sheet pitting” and *Alternaria* decay. Pitting symptoms are

often observed on peppers in supermarkets. Export shipments of peppers to Europe have developed as much as 18 percent *Alternaria* decay following 14 days' transit at 42°F.

Peppers are very susceptible to water loss. Shriveling symptoms, which detract from marketability, may become evident with as little as three percent weight loss. Prompt, thorough cooling and storage in a high relative humidity (95 percent) are suggested. The maximum shelf-life for peppers stored under the suggested conditions (50°F and 95 percent RH) is estimated to be three weeks.