HS792

UF UNIVERSITY of FLORIDA IFAS Extension

Operational Considerations for Harvest - Florida Greenhouse Vegetable Production Handbook, Vol 3[1]

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In this chapter, information is presented on the postharvest physiological requirements of cucumbers, peppers, lettuce, and tomatoes, including recommended harvest and handling practices to achieve optimal storage/shipping life.

Optimal Harvest Factors

Vegetable crops comprise a wide range of plant structures and organs, such as roots (carrots), tubers (potatoes), leaves (lettuce), stalks (celery), immature fruits (cucumbers and peppers), and mature fruits (tomatoes). In order to maximize storage life, crops must be harvested at the appropriate stage of growth, or maturity.

There is a distinction between maturity and ripeness. Horticultural maturity is defined as "the stage of development when a plant or plant part possesses the prerequisites for utilization by consumers for a particular purpose" (Watada, et al., 1984). Cucumbers, lettuce, and peppers are harvested at various stages (horticultural maturity) prior to reaching physiological maturity, or completion of the growth phase. Ripening is a process that occurs in fruits after they have reached physiological maturity. Changes in the postharvest color, texture, and flavor of tomatoes occur during the ripening phase.

The United States Department of Agriculture has published grade standards for greenhouse tomatoes, cucumbers, and leaf lettuce as well as for sweet peppers. The standards cite tolerances, defects, and packing requirements which must be met by the shipper in order for a container to be legally labeled with a governmental grade, such as U.S. Fancy, U.S. No.1, etc. Grade standards for individual commodities can be obtained from the U.S.D.A (see References).

Leaf lettuce is harvested when the leaves are of typical color for the lettuce type being grown, not wilted, and free from defects such as tipburn. The entire plants can be harvested and placed directly into individual plastic sleeves or containers. Roots should be rinsed free of any soil, media, etc. By keeping the roots moist, wilting will be minimized during subsequent handling. The roots can also be trimmed

1. This document is HS792, one of a series of the Horticultural Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Original publication date December 1990. Revised June 2001. Reviewed February 2008. Visit the EDIS Web Site at http://edis.ifas.ufl.edu.

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partially or entirely at harvest. Cucumbers should be picked without stems at the appropriate developmental stage; peppers and tomatoes should be picked with stems attached.

Cucumbers and peppers require frequent, multiple harvests in order to supply a uniformly mature product with optimal quality to the desired market.

Tomatoes are also harvested in multiple harvests when there is some color showing on the fruit surface, usually the breaker (less than 10% color) or turning (10 to 30% color) stages. Multiple harvests necessitate attentiveness on the part of the greenhouse manager and a reliable supply of labor.

Harvesting should be done during the early morning hours to avoid accumulation of additional "field heat." Proper harvesting techniques must also be used to minimize injury. Workers should closely trim fingernails to reduce punctures. Peppers should be grasped so that they are detached with the stems intact. At harvest, the crops should be carefully placed in single or double layer containers to avoid bruising. Once filled with the harvested crop, the containers should be quickly, but carefully, transported to the packing shed to reduce mechanical injuries, such as bruises, abrasions, and cuts. Injuries provide sites for decay infection later during handling and marketing. Harvested vegetables should never be held in direct sunlight which leads to further fruit warming, wilting, or sunscald. For best protection during handling and shipping, these crops should be finally packed in single-layer containers. Fruits should be free of soil, waterspots, etc., and may require washing prior to packing. Containers should be selected for adequate strength to withstand stacking and shipping. Ventilation holes should be present (about 5% of the exposed surface area of the carton) to ensure sufficient air circulation during storage and shipping. Properly designed fiberboard cartons perform very well for these crops (Fig. 1).

Tomatoes are typically placed stemdown. However, tomatoes shipped in this manner will develop flat spots on the shoulders as the fruits ripen and soften. Cucumbers are quite susceptible to water loss. Plastic film wraps, shrinkor wax can be applied to individual cucumbers to reduce shriveling. As

Figure 1. Greenhouse peppers packed in cardboard boxes and palletized for shipping.

mentioned, lettuce can be placed in plastic bags to reduce wilting.

After packing, the containers should be stacked on pallets. By unitizing the containers, subsequent handling operations are greatly facilitated, saving labor costs and reducing mechanical injury which can occur with repeated handling. The stacked containers should be secured on the pallet with strapping, netting, or glue to avoid shifting during handling.

Precooling / Storage

For optimum quality retention during shipping and retailing, these vegetables should be cooled as quickly as possible after harvest and packing. Precooling involves procedures which rapidly cool the crop and, therefore, lower the metabolism rate which slows ripening, retards development of decay, and reduces wilting. Volume 2 of this handbook describes precooling procedures in greater detail. Cucumbers and peppers should be cooled to 50F (10C). Tomatoes which are at the breaker or turning stage should not be cooled below 55F (12C), while tomatoes at pink to light red ripeness stages maybe stored successfully at 50F (10C). Holding these vegetables at temperatures which are lower than recommended temperatures during precooling or during refrigerated storage or transport can cause chilling injury. Chilling injury is expressed by such symptoms as dark, sunken lesions on the vegetable surface, abnormal color development, offand increased susceptibility to decay. It is time/temperature related; in other words, the longer the product is held below the recommended storage

temperature, the greater the extent of chilling injury. Although lettuce is not chilling sensitive, it should not be cooled less than 33F (1C) to avoid freezing. Optimal storage conditions are presented below in Table 1.

All horticultural crops are sensitive to ethylene gas, a naturally occurring plant hormone. However, crops have varied responses to ethylene. Many crops undergo a distinct ripening phase which is characterized by production of relatively large amounts of ethylene. Tomato is an example of this type of crop. Exposure to ethylene can be detrimental to nonethylene producing crops being stored in the same cold room or transported in the same refrigerated trailer with ethylene crops. Lettuce, for example, will develop russet spots when exposed to as little as 1 part per million of ethylene. Peppers and cucumbers will also deteriorate more rapidly when exposed to ethylene as evidenced by loss of green color (yellowing), texture, and flavor (Ryall and Lipton, 1979). Therefore, tomatoes should be held in a separate cold room when these other crops are being stored. Ethylene is also produced from combustion. Exhaust from unit heaters, fork lifts, vehicles, and cigarettes can accumulate in cold rooms and cause injury to the crop. A convenient list of vegetables which are compatible and incompatible for storage shipping is available (Sherman, 1985).

Sanitation

Development of decay during shipping is a major cause of postharvest loss. Decay can be markedly reduced by a routine sanitation program. Such a program should include prompt removal of trash, plant cuttings, diseased plant parts, and culls from the greenhouse, picking containers, packing shed, precooler, and cold room. Whenever water contacts the crop, chlorine should be added at a rate of 100 to 150 parts per million (Hicks and Segall, undated; Sherman et al., undated). Picking containers, packing line components, and cold room floors and walls should be cleaned periodically with chlorine solution to reduce populations of decay organisms. Local environmental regulatory agencies should be consulted for appropriate disposal of packing shed wash water and culls.

Consistently high quality vegetables can be produced and marketed by greenhouse operations by first understanding the biological requirements of the crop for optimal storage life. Then, appropriate harvest and handling techniques can be employed for each crop which will include conscientious attention to maturity indices and grade standards, care in handling, proper packaging, timeliness and thoroughness in precooling, storage at the desired temperature and relative humidity, and implementation of a sanitation program.

References

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More Information

For more information on greenhouse crop production, please visit our website at http://nfrec-sv.ifas.ufl.edu.

For the other chapters in the Greenhouse Vegetable Production Handbook, see the documents listed below:

Florida Greenhouse Vegetable Production Handbook, Vol 1

Introduction, HS 766

Financial Considerations, HS767

Pre-Construction Considerations, HS768

Crop Production, HS769

Considerations for Managing Greenhouse Pests, HS770

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General Considerations, HS774

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Irrigation of Greenhouse Vegetables, HS786

Fertilizer Management for Greenhouse Vegetables, HS787

Production of Greenhouse Tomatoes, HS788

Generalized Sequence of Operations for Tomato Culture, HS789

Greenhouse Cucumber Production, HS790

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Enterprise Budget and Cash Flow for Greenhouse Tomato Production, HS793

Vegetable Disease Recognition and Control, HS797

Vegetable Insect Identification and Control, HS798

Table 1. Optimal storage conditions.

Commodity	°F	°C	Relative Humidity	Storage Life	Acceptable Precooling Method
Lettuce	33	1	95-100%	14-21	VA, HY, PI*
Cucumber	50-55	10-13	95%	10-14	HY, FA
Pepper	45-55	7-13	90-95%	14-21	FA
Tomato	50-55	10-13	90-95%	7-21	Room, FA

*HY = hydrocooling; FA = forced-air; PI = package ice; VA = vacuum cooling.