HS780

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Materials Handling - Florida Greenhouse Vegetable Production Handbook, Vol 2[1]

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Chemicals

Fertilizer materials should be stored in a separate storage building. Humidity in a greenhouse can lead to hardening and caking of some fertilizer salts. Stock tanks should be covered and located away from electrical controllers and switches. This is especially true if acids are being used. The objective is to minimize corrosion of all machinery, equipment, and controllers in the greenhouse.

Fertilizers should be stored in tightly closed plastic containers to keep the material dry. Fertilizers and chemicals must be kept out of easy reach of children and animals. When mixing fertilizers, growers should use clean containers and all containers should be rinsed well after use. Growers need to clearly label all containers and dispose of used packaging materials properly.

Growers should not underestimate the importance of the need to deal effectively with wastewater from greenhouses. Pressure is mounting for agricultural producers to eliminate potential groundwater contamination sources. This means that new growers need to consider wastewater handling as they design their new houses. It means that existing growers will need to take a hard look at their production practices for areas that can be modified to provide for safe disposal of wastewater.

Acids are very dangerous liquids and can cause severe burns. When mixing acids with fertilizer solutions, plenty of fresh water must be available to rinse spills. Growers must remember to always add acid to water. Water or fertilizer solution should never be poured into a container of concentrated acid.

Wastewater Solutions

One of the large problems with hydroponic operations is managing wastewater. It will become more difficult to dispose of the wastewater from the sump after each flush. Reuse of the nutrient solution for farm or lawn irrigation is a good idea at present. Ideally, the best remedy would be to reuse the solution for long periods of time in the greenhouse.

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Unfortunately, the risk of disease organism buildup is too great to permit use for more than a few days up to one week.

One sterilization system that has promise is ultraviolet (UV) light. In this system, the water is passed through a UV sterilization unit as it returns from the greenhouse to the sump. UV light has the capability of destroying certain disease pathogens as long as the exposure time is adequate. With proper filtration to collect organic matter, a hydroponic system with UV light sterilization would avoid a large number of the frequent flushes.

The major problem is that the grower must do an exceptional job of monitoring the nutrient concentrations in the solution. One of the secondary reasons for flushing is to "start over again" with the various concentrations of fertilizer nutrients. With reduced flushing, the grower needs to pay attention to the levels of the various elements and be prepared to adjust them individually.

Postharvest Handling

The primary goal of vegetable harvesting and postharvest handling is to maintain the high quality obtained at harvest through subsequent handling steps (Fig.1). The wise greenhouse operator pays close attention to quality maintenance at each step in this postharvest system. Employees should likewise be trained and encouraged to be "quality conscious." Quality is most often lost due to two causes: mechanical injury from rough handling during harvest, packing, and transport; and inadequate temperature management.

Figure 1. Tomatoes near harvest time.

Mechanical injury includes cuts, punctures, and bruises from excessive impacts. Bruises can also be caused by compression, when containers are overfilled, and by vibration during long transport, when containers are underfilled. These injuries reduce storage life by accelerating ripening and providing entry points for decay organisms.

Proper temperature management requires the rapid removal of field heat to the recommended storage temperature (known as precooling) and the maintenance of that temperature and relative humidity during subsequent storage and transport. Temperature management is discussed later in this chapter.

Reusable picking containers should be selected which provide adequate protection of the crops from physical damage during handling. Padding should be used to separate layers in the containers; layers should not be more than two deep, especially for tomatoes and peppers. These packing materials can be purchased from local suppliers (Fig. 2).

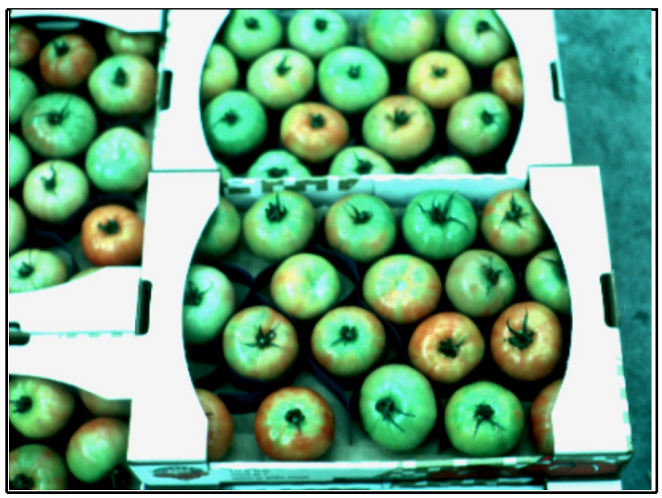

Figure 2. Packed tomatoes ready for shipment.

The packing facility should be located in close proximity to the greenhouse. It should have sufficient space to hold equipment required for washing, sorting, sizing, and packing; packing materials, labels, etc., will also require adjacent storage space. The shed should also adjoin the precooling/cold room facility to facilitate rapid handling. Cucumbers are typically individually shrink-wrapped and lettuce is often overwrapped in plastic sleeves or containers to reduce moisture loss. These procedures add extra equipment and labor costs to the overall operation.

Packing lines should be designed so as to gently handle the crop; injury can occur from excessive drops when the product is transferred from the picking containers to the packing line or during transfer from one packing line component to another. Water receiving/handling systems can be employed to reduce injury when transferring the tomatoes and cucumbers to the packing line, however the water should be chlorinated to reduce populations of decay organisms. In the case of tomatoes, the receiving tank should be heated above the pulp temperature to minimize uptake of the water and accompanying decay organisms through the stem scar.

Ambient conditions also affect packing efficiency. There should be sufficient lighting over sorting rolls for graders to easily discriminate color and defects. Table height and width should be designed to minimize worker reach and maximize worker comfort. Reasonable temperatures should also be maintained in the packing line area.

Careful thought must be given in the selection of shipping containers. An appropriate container should be:

- durable to endure shipping while protecting the product.
- well-vented for rapid precooling and temperature maintenance.
- able to withstand contact with water during precooling or shipment if appropriate, using as waxed, corrugated cartons, or wirebound wooden crates.
- clearly labeled as to crop, grade, count/weight, and shipper.
- designed to stack well on standard 40 by 48 inch pallets and occupy 90%of the pallet surface area.

For larger volume operations, pallets offer the potential for substantial savings in handling time and costs as well as reduced damage through reduction of handling steps. There are significant costs for purchase of forklifts, pallets, and strapping material and related equipment. Forklifts also require wide aisles for turning; aisles about 15 feet wide should be allowed when planning the packing shed and cooling/storage facility. A loading dock, preferably raised to refrigerated trailer bed height, should also be included.

Cucumbers, lettuce, and peppers are normally packed prior to pre-cooling. Rapid pre-cooling is essential to maintain maximum quality. However, once the crop has been pre-cooled, provision must be made to keep the product cold, thus maintaining the "cold chain" through subsequent handling operations until the product reaches the ultimate consumer.

Lettuce can be rapidly cooled with vacuum cooling or hydrocooling. Hydrocooling and vacuum cooling are very efficient for precooling but require the use of dedicated precoolers. Initial investment costs and refrigeration costs can be minimized through use of small size precoolers.

Lettuce can be top-iced by placement of crushed ice on top of the container prior to closure. Ice can be manufactured on-site with an icemaker and ice storage bin, or block ice can be purchased and crushed. Ice should never be applied to cucumbers, tomatoes, and peppers to avoid development of chilling injury.

Peppers and tomatoes should be precooled with refrigerated air, since contact with water can increase incidence of decay. An existing cold room can be modified fairly easily in order to perform forced-air precooling. Air flow through the containers is increased by means of a high capacity fan connected to a specially constructed plenum in the cold room. Two rows of pallets are placed next to the plenum and a tarp is placed over the rows of pallets. High relative humidity (above 90%) should always be maintained in the forcedprecooler to minimize water loss from the crops. Extra refrigeration capacity is also required to remove the heat efficiently.

For all precooling methods, the cooling rate is directly related to three factors: precooling time, precooling medium temperature, and precooling medium contact with the product surface. The precooling operation should be designed to remove 7/8 of the field heat; the remaining heat is removed in the cold room. This so-called “7/8 cooling” can be efficiently achieved only when:

- the product is held for sufficient time in the precooler.
- the precooling medium is maintained at constant temperature.
- the cooling medium freely circulates over all surfaces of the product (due to proper stacking and stacking of containers to ensure maximum ventilation).

The product pulp temperature should be measured before and after precooling to ensure proper operation.

Precoolers and cold rooms should be designed and constructed by refrigeration contractors with experience in the perishable produce industry. Cold rooms should be constructed to maintain relative humidity above 90% through use of appropriate vapor barriers in the building and addition of moisture with humidifiers.

Proper design of the postharvest system is essential to facilitate rapid, yet careful handling, packing, and precooling of the crops. This will permit shipment to markets while maintaining the highest possible quality.

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

Florida Greenhouse Vegetable Production Handbook, Vol 2

Florida Greenhouse Vegetable Production Handbook, Vol 3

Vegetable Disease Recognition and Control, HS797

Vegetable Insect Identification and Control, HS798