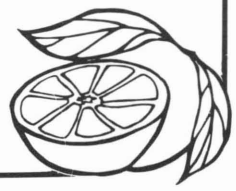
Texas Agricultural Extension Service

Texas Citrus Harvesting and Pre-pack Handling



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The logical culmination of citrus production efforts is the harvesting and subsequent movement of the crop into marketing channels enroute to the ultimate consumer. Total volume, quality and size of fruit have been established by production practices and the impact of climate. However, proper harvesting and post-harvest handling and storage practices are necessary to minimize losses during distribution and to assure that only good quality Texas citrus reaches the consumer.

Maturity Standards

Texas citrus cannot be harvested until the fruit achieves legal maturity as defined by Texas state law and regulations. Legal maturity is based upon both total soluble solids in the juice and its ratio to the anhydrous citric acid content of the juice. As total soluble solids increase through the season, the acceptable minimum ratios decrease (Table 1). Texas maturity standards apply to all citrus marketed in Texas.

Table 1. Texas citrus maturity standards.

Grapefruit		Oranges	
Total soluble solids	Minimum ratio[1]	Total soluble solids	Minimum ratio[1]
9.0	7.2:1	9.0	9:1
10.0	7.0:1	8.5	10:1
11.0	6.8:1		
11.5	6.5:1		

[1]Ratio of total soluble solids to anhydrous citric acid in the juice.

Some early season oranges may not have adequate natural peel color development, even though they are mature. Because the consumer expects oranges to be orange, color may be added during packing. Regulations prohibit adding color to oranges which do not meet maturity standards and further stipulate that color cannot be added unless the juice content is at least 4.5 gallons per standard packed box of 1.6-bushel capacity, the juice to be extracted by hand, without pressure. Moreover, 55 percent of all color-added fruit in each lot must be stamped to indicate that color was added. In addition, color can only be added to bring fruit color up to natural color.

Harvesting

Citrus harvesting in the Lower Rio Grande Valley normally begins in October and lasts into April or May. All Texas citrus is harvested by hand, primarily by harvest crews employed by the respective buyers (packers/shippers). Prototype mechanical harvesters have not proven feasible for harvesting fresh fruit because of tree damage, fruit damage, non-selectivity, efficiency and cost.

Clean-tree harvesting of all fruit on the tree is rarely practiced in Texas until near the end of the season, primarily because of market constraints relating to fruit size. The smaller fruit sizes are not acceptable in Texas citrus markets, so most harvesting is by ring picking, i.e., sizing rings are used to selectively pick only those fruits which exceed a specified minimum size.

Ring sizes correspond to the number of fruit of a given size required to fill a standard 1.6-bushel box. Thus, size 96 requires 96 fruits to fill the standard box, size 80 requires 80 fruits, et cetera. The standard 1.6-bushel box is a legal entity but it is no longer used in commerce, having been replaced by other containers, the most common of which is the almost 7/10-bushel carton currently in use. The relationship between picking ring sizes and shipping sizes is 2:1 (picking ring size 96 equals packed size 48).

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Most grapefruit harvesting is done on the basis of the 96 ring; oranges are not commonly harvested with a ring. However, larger ring sizes may be used in specific situations, particularly for a specialty market such as gift fruit shipments.

Ring-picking is less efficient than clean-tree harvesting but it reduces early-season eliminations of undersized fruit in the packinghouse. In addition, leaving undersized fruit on the tree allows it to increase in size as the season progresses. Ring-picking may be used two or three times in grapefruit orchards before a final clean-tree harvest near the end of the season. Oranges are normally ring-picked only once in the very early season.

Individual fruits are picked with a combination pull-twist-snap motion which leaves the woody stem and button (calyx) on the tree. Ladders are used to reach fruit in the tops of trees. The fruits are dropped into picking sacks equipped with a quick-opening bottom. When filled, the sacks are emptied into bin boxes which hold approximately 1,000 pounds of fruit. The filled bins are then stacked two or three high and loaded onto flatbed trucks or trailers for transport to the packinghouse.

Picking rates vary with the individual picker, type of fruit, relative abundance of fruit, tree size and other factors. However, experienced pickers should average 10 to 12 bushels of oranges and 14 to 16 bushels of grapefruit per hour in ring-picking. Harvest crews work as a unit to pick and haul the fruit to the packinghouse, so rates are based on total tons delivered. Current pick and haul rates are about $21 and $26 per ton for grapefruit and oranges, respectively.

It is a popular misconception that citrus fruit can withstand rough handling. Citrus is more durable than many other fruits, but it does bruise easily—the difference is that citrus bruises may take several days to become evident, by which time the fruit usually has been shipped. Consequently, rough handling should be avoided during harvesting operations.

Stems left on the fruit at picking must be removed during packing, which reduces packing efficiency. Of more importance is the fact that stems left on the fruit can damage other fruit, thereby causing spoilage and fruit loss. Careless picking that results in plugging, i.e., part of the rind pulls loose from the fruit, is unacceptable. All citrus can be susceptible to plugging, but some varieties are worse than others, e.g., pineapple oranges, many tangelos and most tangerines. The latter types are clipped rather than pulled.

Ladder placement in the tree should be done carefully to avoid damaging fruit on the tree and limb breakage. Experienced pickers ease the ladder edgewise into the tree before rotating it into climbing position.

Bin boxes must be smooth inside and free of rough edges or protrusions which can damage fruit. Bins should not be filled higher than 2 inches below the top, as space must be left to permit forklifts to stack other bins on top. Picking sacks are designed to empty from the bottom so that fruit can roll out of the sack onto the bottom of the bin or atop fruit already present, rather than being dropped.

Forklift operators should raise and lower filled bins smoothly, as sudden stops in either direction can be as damaging as dropping the fruit. While speed in harvesting and fruit transfer is important, speed should not be achieved at the expense of careful handling. Practical means of shading fruit between harvest and unloading at the packinghouse should be developed and used to further enhance the keeping quality of citrus.

Oleocellosis, or oil spotting (also known as oleo and green spot), is a handling problem which normally does not show up for several days after harvest. It results from mechanical damage which forces oil from the epidermal oil glands in the peel. The oil kills adjacent cells in the peel and also can damage other fruit that it contacts. Turgid fruits are most likely to develop oleocellosis because the oil glands of turgid fruit are more easily ruptured. Fruit turgidity is greatest in the early morning and under foggy, wet conditions. Harvesting under such conditions or while dew is on the fruit should be avoided. Marrs oranges are particularly susceptible to oleocellosis.

Packinghouse Procedures

The citrus packinghouse is a combination of facilities, machinery, equipment, personnel and

procedures which converts harvested fruit into acceptable market-ready packages. This process involves cleaning, waxing, grading, sizing, fungicidal treatment and final packing, and also may include degreening and coloring. No two packinghouses are identical in size, layout or efficiency, but all are similar. The following discussion is based on a logical and economical flow of fruit from the orchard to the final package.

The working area of the packinghouse is divided into three basic sections: pre-packingline (unloading, degreening, temporary storage), packingline and post-packingline (assembly and loading of packed fruit). The degreening rooms can be used for storage when not in operation. The packingline is the determining factor in the size of the packinghouse as its capacity determines the amount of fruit which can be handled.

Pre-packingline

After fruit trucks are weighed, the fruit is unloaded by forklift and transferred either to temporary storage, degreening rooms or directly to the dumper. Maturity test samples may be obtained at this point. Packinghouse personnel also may inspect the fruit to estimate pack-out, grade and size range.

Degreening

Degreening also is called gassing, sweating or curing. Its purpose is to remove the green color from otherwise mature fruit. Degreening is used primarily in the early fall when night temperatures have not been low enough for the peel to develop its characteristic mature color. Late oranges such as Valencia sometimes regreen during the spring growth flush and may need to be degreened, also.

Recommended degreening conditions include 82° to 85° F temperature, 92 to 95 percent relative humidity and 1 to 5 ppm ethylene. Air circulation within the degreening room should produce about one change per minute. In addition, outside air ventilation should be adequate to maintain carbon dioxide level below one percent, which normally requires about one complete change of air per hour.

Degreening time varies with the amount of green color, size of fruit and some cultural practices, e.g., excessive nitrogen fertilization promoting vigorous growth and oil-emulsion sprays after mid-July. Maximum degreening times are 60 to 72 hours for grapefruit and 48 to 60 hours for oranges, but the degreening period should be as short as possible.

Degreening room designs are highly variable, with various degrees of automation with regard to monitoring devices for temperature, humidity, ethylene and carbon dioxide. The current optimum design includes a false ceiling to house fans, heaters, vents, steam humidifier, ethylene metering device and automatic monitoring/regulating equipment. The rear wall uses T-shaped separators, spaced box width apart to serve as vertical air ducts. Rows of eight to 10 boxes stacked four to six high against the rear wall allow horizontal air flow between the aligned pairs of box runners, from which air moves up into the fruit through slots in the bottoms of the boxes. Return air flow is from the front of the room back into the false ceiling for monitoring and recirculation. A suitably wide aisle is left at the front of the room for maneuvering forklift trucks. Air-curtain entry and exit doors can be installed to permit loading or unloading during continuous degreening operations.

Degreening rooms typically are used as storage areas when not in operation, which is most of the season. With the addition of insulation, vapor barriers and refrigeration equipment, degreening rooms could be better used as cold storage rooms. Incoming fruit temperatures sometimes can be quite high, which, when combined with occasional low relative humidity situations, could raise degreening room temperature well above optimum. Consequently, refrigeration to prevent elevated degreening room temperatures may be necessary to maintain fruit quality during and after degreening.

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