

Harvest Maturity Indices

The most commonly used methods of determining lemon maturity are peel colour and size. Lemons may be picked either at the dark green colour stage or when the peel has started to turn yellow. Fruit left on the tree to turn slightly yellow will have higher juice content, but a shorter shelf life. Lemons for export should have at least some yellow colouration of the rind at harvest.



Fruit size may also be used to determine harvest maturity. Lemon fruit with a diameter less than 5 cm (2 in) are generally not fully developed and have less than the preferred juice content. Fruit intended for export should meet or exceed the minimal diameter of 5 cm.

Juice volume is the most commonly used internal method for determining harvest maturity. Random samples of fruit of similar size are harvested and the percent juice content is measured. The generally accepted standard for proper harvest maturity is a minimum juice content of 28% by volume. Lemon fruit from the size groups meeting the minimum juice content should be harvested.

Harvest Methods

Lemons should be harvested by carefully twisting and pulling the fruit from the tree. The button (calyx and disk) should remain attached to the fruit. Overhanging stems left attached to the fruit should be removed with a clippers to avoid damage of nearby fruit in the harvest container. Careless picking that results in plugging, i.e., part of the rind pulls loose from the fruit, is unacceptable. Never shake the tree to harvest the fruit. The harvested fruit should be carefully put into padded field crates or well-ventilated plastic containers. Lemons should not be placed in large synthetic sacks. They provide limited protection to the fruit and overstuffing can result in considerable bruising. Harvested lemons should be put in a shaded area as soon as possible after harvest.

Preparation for Market

De-greening

Lemon fruit may have enough juice content for harvest when the peel is still green, but most export markets prefer yellow coloured lemons. In order to change the external colour and de-green the peel, lemons can be exposed to either ethylene gas or liquid ethylene. The de-greening process involves exposing green-skinned lemons to low levels of ethylene (usually between 1 to 10 ppm) at 20°C to 25°C (68°F to 78°F), 90% relative humidity for several days. Too much ethylene (above 10 ppm) can cause stem end rot and increase decay. Good internal air movement is necessary in the de-greening chamber and regular ventilation with fresh outside air is needed to keep the CO₂ levels low (below 2000 ppm).

A liquid ethylene-releasing compound, called *ethephon*, is another effective de-greening agent. It is applied by dipping the lemons for 1 minute in a tank of clean water with 500 ppm ethephon. De-greening should always be done prior to waxing.

Cleaning

Washing lemons after harvest is needed to improve the appearance of the fruit by removing dirt, sooty mould, insects, and spray residues. Lemons can be cleaned by hand rubbing or brushing individual fruit in a tank of sanitized water. The wash water should be sanitized with 150 ppm hypochlorous acid (household bleach) maintained at a pH of 6.5. This is equal to 2 oz of household bleach (such as Marvex) per 5 gallons of water, or 0.3 liters of bleach per 100 liters of water.

Lemons can also be cleaned mechanically by passing the fruit over a series of soft-bristled roller brushes. Benomyl (500 ppm), thiabendazole (TBZ) (1000 ppm), or imazalil (1000 ppm) are the most effective postharvest fungicides for lemons and can be applied as high pressure sprays after washing.

Sorting

The main characteristics used in sorting the fruit are amount and evenness of yellow colour, size, shape, smoothness, and freedom from damage and decay. The fruit within each grade should be uniform in appearance and not have any noticeable marks. Lemons with discoloured peels and bruised or wrinkled skins should not be packed for the fresh market. Lemons packed for export should have a uniform yellow colour and should be separated into different size

categories ranging from 75, 95, 115, 140, 165, 200 and 235-count individual fruit numbers per 18 kg (40 lb) carton.

Waxing

Lemon fruit benefit from a postharvest wax application. Waxing slows moisture loss and the rate of shrivel, thereby extending market life. Water-emulsion waxes do not require completely dry fruit, so the wax can be applied right after washing and grading. In small volume operations, the wax can be applied by hand rubbing individual lemons with a water-emulsion wax soaked cloth. Larger volume operations apply the wax from overhead spray jets as the fruit is moving underneath on a series of slowly rotating horsehair-type roller brushes.

A carnauba water-emulsion wax is preferred because of better gas exchange and less likelihood of juice fermentation. A fungicide can be added to the wax to prevent postharvest decay.

Packing

Lemons should be packed in strong, well-ventilated containers. Wooden crates are acceptable for the domestic marketing. Large synthetic sacks holding more than 30 kg (66 lb) of fruit should not be used.



Commonly used export container sizes are a 5 kg (10 lb) mini-pack and an 18 kg (40 lb) fiberboard carton. Lemon size categories packed in the full carton range from extra-large (75-count) to small (235-count).

Temperature Management

The best postharvest storage temperature for lemons depends on skin colour. Green lemons should be stored at 12°C (54°F) and at this temperature have an estimated storage life of up to 4 months. Yellow coloured lemons should be stored at a slightly cooler temperature, ideally at 10°C (50°F). Possible storage life at this temperature will be several months. Lemons are at risk to chilling injury if held at temperatures below 10°C (50°F). CI symptoms include pitting and sunken lesions on the peel surface, skin discoloration, decay, and off-flavour.

Relative Humidity

In order to minimize moisture loss and maintain postharvest fruit quality, lemons should be stored at a relative humidity (RH) of 90% to 95%. At a low RH the peel will lose water and become shriveled within several weeks. This will negatively affect the appearance and market potential of the fruit.

Principal Postharvest Diseases

Lemons are at risk to a number of postharvest fungal diseases. The fruit should be harvested and handled gently to avoid bruising and skin injury, which speeds up postharvest microbial decay. Less postharvest decay is also achieved by the use of proper pre-harvest and postharvest fungicides (500 ppm benomyl or 1000 ppm TBZ or imazalil), correct sanitation of the wash water, and prompt cooling to 12°C (54°F). In addition, sufficient ventilation during storage is necessary to remove ethylene, which increases the degree of many postharvest diseases. Small pads treated with the fungistat diphenyl (at the rate of 4.7 gm/23 kg fruit) are beneficial in slowing decay development when placed inside export cartons.

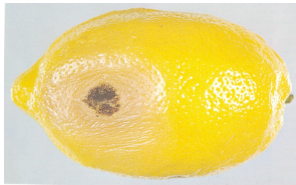
Green Mould

Green mould is one of the worst postharvest diseases of lemons. It first appears as a soft, watery, slightly discoloured spot on the rind, which soon enlarges and develops into a rot that penetrates the peel. White fungal growth appears on the fruit surface and soon after olive-green spores are produced. The sporulating area is surrounded by a broad zone of white fungal growth and an outer zone of softened rind. If the storage RH is low, the whole fruit shrinks to a wrinkled, dry mummy. If the RH is high, the fruit collapses into a soft, decomposing mass.



Blue Mould

Early signs of blue mould are similar to green mould. A white, powdery fungal growth develops on the lesion surface, and soon a blue spore mass forms. A noticeable halo of water-soaked, faded tissue surrounds the spots between the edge of the fungal growth and the healthy tissue. Unlike green



mould, blue mould spreads in packed containers and results in nests or pockets of diseased fruit.

Black Mould

External signs begin as a very soft sunken water-soaked spot on the peel. The spot enlarges and black spores resembling soot appear in the center. The decay is accompanied by a fermented odour. Internal symptoms of black mould include the development of masses of black powdery spores that become obvious when the fruit is cut open.



Brown Rot

Symptoms appear as a firm, leathery, light brown discoloration of the peel. A white fungal growth develops on the peel during humid conditions. Infected fruit have a strong, rancid odour.

Postharvest Disorders

Oleocellosis

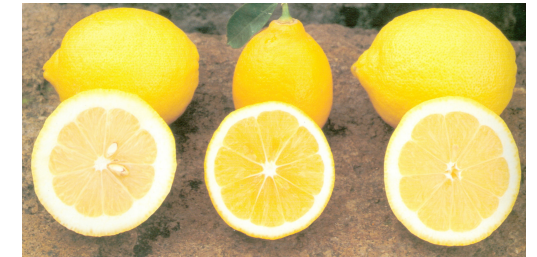
When the lemon peel is split, oil leaks out resulting in skin damage and the formation of irregularly shaped yellow, green, or brown spots. Turgid fruits are most likely to have oleocellosis because their oil glands are more easily ruptured. Fruit turgidity is highest in the early morning and under humid, wet conditions. Oleocellosis can be minimized by picking fruit in the afternoon of sunny days, waiting to harvest 2 or 3 days after a rain or an irrigation, using padded harvest containers, and having pickers wear cotton gloves.



New Guyana Marketing Corporation

LEMONS

Postharvest Care and Market Preparation Information Sheet



Technical bulletins also available on Waxing Fruits and Vegetables. Contact:

New Guyana Marketing Corporation (NGMC)
87 Robb & Alexander Sts., Georgetown, Guyana
Tel: 226-8255, 226-2219

National Agricultural Research Institute (NARI)
Mon Repos, East Coast Demerara, Guyana Tel: 220-2950



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This information sheet provides growers and agriculture extension personnel with a summary of the recommended harvest and postharvest handling practices for lemons. A more technical and detailed bulletin is available from the New Guyana Marketing Corporation (NGMC) and the National Agricultural Research Institute (NARI).