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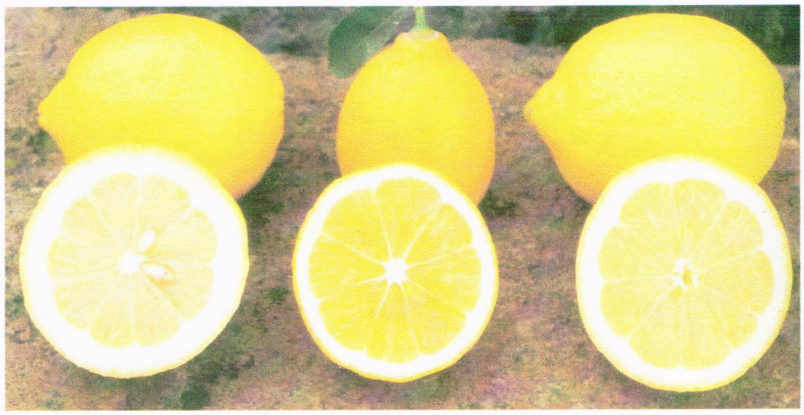
Postharvest Handling
Technical Bulletin

LEMONS

Postharvest Care and Market Preparation



Technical Bulletin No. 29

May 2004

POSTHARVEST HANDLING TECHNICAL SERIES

LEMONS

Postharvest Care and Market Preparation

Ministry of Fisheries, Crops and Livestock
New Guyana Marketing Corporation
National Agricultural Research Institute

Technical Bulletin No. 29

May 2004

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Preface

This publication is part of a series of technical bulletins that seeks to provide specific recommendations for improvements in postharvest care and market preparation for selected non-traditional agricultural products. The intended audience for this series is primarily extension agents.

Initial market assessments in current export markets and visits with producers and exporters in Guyana have shown the quality of fresh produce currently exported is uneven and in some instances very poor. Stages all along the export chain from harvest and pre-harvest to transportation and final export are all in need of improvement. Pre-harvest practices, sanitation at the packinghouse, packaging, bacterial and fungal problems, and transportation were all identified as areas where improvement could benefit the quality and increase the shelf life of Guyana's fresh produce exports. The technical bulletins address these issues specific to each product. Harvesting techniques and crop maturity indices are provided. Preparation for market, including cleaning, sorting, packing and transportation are covered. The bulletins address and recommend specific storage conditions, covering temperature and humidity controls. Finally the bulletins address postharvest diseases and insect damage.

The undertaking of these technical bulletins is a joint effort of the Ministry of Fisheries, Crops and Livestock; the New Guyana Marketing Corporation (NGMC) and the National Agricultural Research Institute (NARI) to improve quality, increase production and promote exports. As a team, the three agencies are working on the problems, limitations, and constraints identified in the initial reconnaissance surveys, from production and postharvest handling problems, to packaging and transportation, to final market.

Introduction

Lemons (*Citrus limon*) are a minor citrus fruit in Guyana, produced mostly for the domestic fresh fruit and juice markets. Grafted trees begin bearing fruit within 3 years after transplanting. Lemon fruit have a relatively long postharvest life in comparison with other types of citrus.

Harvest Maturity Indices

The most commonly used non-destructive indices of harvest 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 picked at the dark-green stage have the longest postharvest life, but generally have not reached their maximum juice content. Fruit left on the tree to turn slightly yellow will have higher juice content, but a shorter market life. Export market lemons should have at least some yellow colouration of the rind at harvest (Figure 1).

Fruit size may also be used to determine harvest maturity. Lemon fruit with a diameter less than 5 cm (2 in) are generally not sufficiently developed and have less than the desired juice content. Fruit intended for export should meet or exceed the minimal diameter of 5 cm and pickers should carry a wire ring of this diameter as a reference guide to avoid harvesting undesirably small fruit.

Figure 1. Lemons destined for export should have some yellow colouration.

Juice volume is the most commonly used internal index for determining harvest maturity. Random samples of fruit of similar size are harvested and the % 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 categories meeting the minimum juice content should be harvested.

Harvest Methods

Lemons should be harvested by carefully twisting and pulling the fruit from the tree (Figure 2). The button (calyx and disk) needs to remain attached to the fruit. Protruding stems left attached to the fruit should be removed with a clippers to avoid puncture damage of adjacent fruit in the harvest container. Careless picking that results in plugging, i.e., part of the rind pulls loose from the fruit, is unacceptable. Avoid rough harvesting practices which result in

Figure 2. Harvest lemons carefully so the stem remains attached to the fruit.

fruit bruising. Never shake the tree to harvest the fruit. Any fruit which falls to the ground is likely to be severely bruised and subject to postharvest decay. The harvested fruit should be carefully put into padded field crates, well ventilated plastic containers, or picking bags. Ladders may be needed to facilitate harvesting of fruit borne on tall trees.

Lemons should be put in a shaded area as soon as possible after harvest. The use of large non-ventilated synthetic sacks as harvest containers should be discouraged. These sacks do not provide protection to the fruit against compression injury, particularly if they are stacked on top of each other. They also do not allow for dissipation of heat and the lemons inside will be more susceptible to decay, especially if the fruit remains in the sack for several days.

Preparation for Market

The lemons should be brought to the packing area soon after harvest to begin the steps of preparing the fruit for market. These steps involve cleaning, grading, and packing. In addition, fruit destined for export may need to be treated with ethylene in order to improve the external peel colour. The ethylene treatment should be done prior to cleaning, grading, and waxing.

De-Greening

Lemon fruit may have sufficient juice content for harvest when the peel is still green. However, some export markets prefer yellow coloured lemon fruit. In order to change the external colour and de-green the peel, lemons can be exposed to either ethylene gas or liquid ethylene. These treatments break down the green chlorophyll pigment in the peel surface and allow the yellow carotenoid pigments to be expressed. Ethylene treatment is solely cosmetic in effect and does not alter the flavour of the fruit or the juice content.

The de-greening protocol involves exposing green-skinned lemons to low concentrations of ethylene (usually between 1 to 10 ppm) at 20-25°C (68-78°F), 90% relative humidity for several days. The optimal ethylene concentration and treatment duration varies by the cultivar and growing conditions. Excessive ethylene (above 10 ppm) can cause stem end rot and increase decay. In order to achieve good de-greening results, adequate internal air movement is necessary. Also, regular ventilation with fresh outside air is needed to keep the CO_2 levels inside the treatment chamber low enough (below 2000 ppm) to avoid the inhibition that high CO_2 levels have on the effectiveness of ethylene.

A liquid ethylene-releasing compound, called ethephon [(2-chloroethyl) phosphonic acid], 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. It is important that the water be properly sanitized with chlorine (150 ppm hypochlorous acid at a pH of 6.5). A fungicide should also be added to prevent postharvest decay. Recommended fungicides are benomyl (500 ppm active ingredient) or thiabendazole or imazalil (1000 ppm active ingredient).

A negative consequence of de-greening lemons is the increase in senescence of the stem end and abscission of the button. De-greening should always be done prior to waxing. The wax coating will partially restrict gas exchange through the peel and inhibit the action of ethylene.

Cleaning

Washing of the lemons after harvest is necessary to improve the appearance of the fruit by removing dirt, sooty mould, scale insects, and spray residues. Lemons can be cleaned manually by hand rubbing or brushing individual fruit dumped in a tank of sanitized water with detergent. Either sodium hypochlorite or sodium o-phenylphenate (SOPP) can be used as sanitizing agents for the wash water. Sodium hypochlorite is readily available in the form of household bleach. It is typically sold in a 5.25% solution. The wash water should be sanitized with a 150 ppm sodium hypochlorite concentration and maintained at a pH of 6.5.

Lemons can also be cleaned mechanically by passing the fruit over a series of soft-bristled roller brushes. The lemons are thoroughly wetted as they pass under a series of spray nozzles. Rotating brushes will remove most of the debris. Soap or detergent may be added to the fruit to improve the effectiveness of the cleaning operation as the fruit continues across the brushes. Adequate cleaning usually requires about 30 seconds on the brushes, rotating at about 100 rpm. The fruit is then thoroughly rinsed as it passes over the last of the brushes. Excess water on the fruit can be eliminated with sponge rollers. The lemons may then continue down a slow moving conveyor belt for sorting and grading or be put on a mesh or screen table for drying and eventual grading.

Thiabendazole (TBZ), imazalil, and benomyl are the most effective postharvest fungicides for lemons and can be applied as high pressure sprays after washing. They are typically applied at a dose of 500 to 1000 ppm active ingredient in water. These fungicides can also be applied in water-emulsion waxes.

Sorting

Immediately after washing the lemons should be sorted into different grades based on external appearance. The main characteristics used in categorizing the fruit are intensity and uniformity of yellow colour, size, shape, smoothness, and freedom from damage and decay. The fruit within each grade should be uniform in appearance and void of noticeable blemishes. 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 peel colour (Figure 3). The fruit should be separated into different size categories ranging from 75, 95, 115, 140, 165, 200 and 235-count individual fruit

Figure 3. Export quality lemons of uniform yellow peel colour.

numbers per 18 kg (40 lb) carton. The 75-count fruit is classified as extra large, while the 235-count is considered small size.

Waxing

Lemon fruit benefit from a postharvest wax application. Much of the surface wax on the peel of the fruit is removed during cleaning. Waxing retards 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 manually by rubbing individual lemons with a water-emulsion wax soaked cloth. Larger volume operations will find it more efficient to apply the wax automatically from overhead spray jets as the fruit is moving underneath on a series of slowly rotating (not more than 100 rpm) horsehair-type roller brushes.

Care must be taken to avoid over-application of the wax. Too thick a coat may restrict gas exchange through the peel and create an internal oxygen deficiency. This may result in the development of off-flavours. A carnauba water-emulsion wax is preferred over a shellac-based wax because of better gas exchange and less likelihood of juice fermentation. A fungicide can be incorporated in the wax to prevent postharvest decay. Recommended fungicides are thiabendazole or imazalil (2000 ppm) or benomyl (1000 ppm). The fungicide concentration incorporated in the wax is double the amount recommended in wash or spray water.

Packing

Lemons should be packed in strong, well-ventilated containers. Wooden crates are adequate for domestic marketing. However, large sacks holding more than 30 kg (66 lb) of fruit should not be used. Fruit inside the sacks are not adequately protected and considerable compression bruising will occur.

Lemons destined for export are packed in various sized containers depending on the destination. Commonly used export container sizes are a 5 kg (10 lb) mini-pack (Figure 4) and an 18 kg (40 lb) full carton fiberboard box having a minimum test strength of 275 psi. Lemon size categories packed in the full carton range from extra large (75-count) to small (235-count).

Figure 4. Lemons packed in a 10 lb mini-pack wood crate covered with soft mesh.

Temperature Management

The optimal 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, with 10°C (50°F) being ideal. Potential storage life at this temperature will be several months.

Relative Humidity

In order to minimize moisture loss and maintain postharvest fruit quality, lemons should be stored at their optimum 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 impact the appearance and market potential of the fruit.

Principal Postharvest Disease

Lemons are susceptible to a number of postharvest fungal diseases. Some of the pathogens attack the fruit prior to harvest, but exist in a resting state until the conditions are right for infection. Others infect the fruit only after harvest. Lemons should be harvested and handled gently to avoid bruising and skin injury, which greatly accelerates postharvest microbial decay. Reduction of postharvest decay is also achieved by the use of appropriate pre-harvest and postharvest fungicides, proper sanitation of the wash water, and prompt cooling to 12°C (54°F). In addition, adequate ventilation during storage is necessary to remove ethylene, which increases the severity of many postharvest diseases. Small pads treated with the fungistat diphenyl (at the rate of 4.7 gm/23 kg fruit) are beneficial in retarding decay development when placed inside export cartons.

The main postharvest lemon diseases in Guyana are various moulds, black rot, brown rot, anthracnose, stem-end rot, sour rot, and cottony rot.

Green Mould

Green mould, caused by the fungus *Penicillium digitatum*, is typically the worst postharvest disease of lemons. It attacks injured areas of the peel and first appears as a soft, watery, slightly discoloured spot on the rind. The spot enlarges to several centimeters in diameter within a day at ambient temperature, and the rot soon penetrates the juice vesicles. 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 (Figure 5). The spores are easily dispersed if the fruit is moved. 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

Figure 5. Advanced stages of green mould on lemons.

mass. The decay spreads very little in packed cartons, but masses of spores produced on one infected fruit can soil surfaces of healthy fruit with green-coloured spores.

This disease develops most rapidly at about 24°C (75°F). It can be minimized by using good pre-harvest sanitation practices; careful harvesting and handling to avoid injuries to the peel; a postharvest dip or spray with a benzimidazole fungicide (i.e. 500 ppm benomyl, or 1000 ppm thiabendazole or imazalil); and holding the fruit at 12°C (54°F).

Blue Mould

Blue mould, caused by the fungus *Penicillium italicum*, is another common postharvest disease of lemons, but is usually less prevalent than green mould. Early symptoms are similar to green mould. Diseased tissue becomes soft, watery, and slightly discoloured and is easily punctured. The lesions enlarge more slowly than those of green mould. A white, powdery fungal growth develops on the lesion surface, and soon a blue spore mass forms, leaving only a narrow white fringe of fungal growth surrounding the lesion. A pronounced halo of water-soaked, faded tissue surrounds the lesion between the fringe of fungal growth and the sound tissue. The blue spores covering the fruit may become brownish-olive with age. Healthy fruit in packed containers become soiled by spores shed from the diseased fruit. Unlike green mould, blue mould spreads in packed containers and results in nests or pockets of diseased fruit (Figure 6).

Figure 6. Pocket of blue mould infected lemon fruit.

Like green mould, blue mould develops most rapidly at about 24°C (75°F). However, blue mould grows better than green mould at cool temperatures and may predominate over green mould in yellow coloured lemons stored at 10°C (50°F). Immediate cooling after packing significantly delays development of blue mould, especially if the fruit storage temperature can be maintained at 12°C (54°F). Additional disease control recommendations are identical to those listed for green mould.

Black Mould

Black mould, caused by the soil-borne fungus *Aspergillus niger*, infects lemons only at fairly high temperatures and only after they have been weakened in some way. External symptoms begin as a very soft sunken water-soaked spot on the peel. The spot enlarges and black spores resembling soot appear in the center (Figure 7). The decay is accompanied by a fermented odour. Internal symptoms of black mould include the development of masses of black powdery spores which become obvious

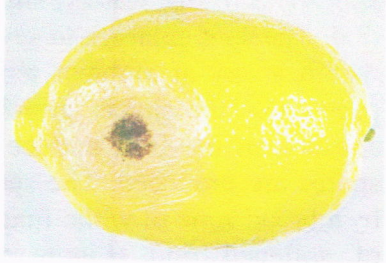

Figure 7. Black mould of lemon fruit.

when the fruit is cut open. Harvesting and handling wounds predispose lemon fruit to infection. The fungus may also invade the peel through cuts in the skin or a stem-end injury. Black mould develops rapidly at ambient temperature and spreads to adjacent fruits. In mixed infections, it tends to outgrow other fungi.

Control of black mould is obtained by avoiding damage to the peel tissue and storing the fruit at 10°C to 12°C. Decay is insignificant at temperatures below 15°C.

Gray Mould

Gray mould, caused by the fungus *Botrytis cinerea*, is a common postharvest disease of lemons during cool temperature storage under high humidity. Symptoms appear as a brown leathery decay of the peel, with gray-brown to olive spore masses forming around the affected areas of the fruit surface (Figure 8). The disease spreads readily by contact with adjacent fruit, giving rise to large nests of diseased fruit in packed containers. Optimal temperatures for growth of the fungus are between 18°C to 23°C (64°F to 73°F). However, some growth will also occur at the recommended cool storage temperature. Proper field sanitation, pre-harvest fungicide sprays, and prevention of wounds on the fruit help reduce the incidence of gray mould.

Figure 8. Gray mould of lemons.

Black Rot

Black rot, caused by the fungus *Alternaria citri*, is a serious disease in lemons that have been stored for more than one month. The fungus typically enters the fruit through the button and stem-end decay occurs. Lesions developing from infections of the button become light brown to black in colour, and gradually progress over the fruit surface from the blackened button towards the stylar-end. As the button deteriorates during storage, the fungus grows from the surface into the fruit. The pathogen will seldom invade a green button, so it is important to prevent button desiccation. Entrance of the fungus into the fruit is also aided by mechanical injury or cracks in the peel. Fruit harvested over-mature are more susceptible to black rot. Advanced symptoms of black rot include a blackish-green fungal growth on the fruit surface. Internally, the tissue turns black in the center of the fruit. The decay does not spread from infected to healthy fruit in packed containers.

Control of black rot is obtained by pre-harvest fungicide sprays to lower the inoculum level, careful harvesting to avoid wounding of the tissue, applying 2,4-D as a 500 ppm dip to delay button senescence, and storage of the fruit at 12°C. Black rot development in lemons can be reduced by a pre-harvest foliar spray of gibberellic acid. Black rot is also retarded by postharvest applications of 2,4-dichlorophenoxy acetic acid at a dose of 500 ppm, which delays senescence of the button.

Brown Rot

Brown rot, caused by the fungus *Phytophthora*, is a common postharvest decay of lemons during high amounts of rainfall. Lemons hanging low on the tree are often infected by rain-splashed soil. Winds can then spread the actively growing fungus to fruit in the upper tree. The disease generally occurs during the later stages of fruit development. Symptoms of brown rot appear as a light brown discolouration of the peel (Figure 9). The affected area is firm and leathery. A white fungal growth develops on the peel during humid conditions. Infected fruit have a pungent, rancid odour, which distinguishes this disease from other rots.

Control of brown rot is obtained by a combination of field sanitation, pre-harvest sprays of copper or fosetyl-Al (Aliette) fungicides, disinfection of the harvest containers, and wash water sanitation. Holding green lemons at 12°C and yellow lemons at 10°C will significantly retard the development of brown rot. Immersion of the fruit in a hot-water bath at 46°C to 48°C (115°F to120°F) for 2 to 4 minutes kills the fungus provided it is confined to external layers of the rind. Fungus that has penetrated well below the rind will survive the heat treatment. Turgid lemons may be injured by the heat treatment and should be allowed to wilt for 1 or 2 days before treatment.

Figure 9. Brown rot of lemon fruit with white fungal growth.

Anthracnose

Anthracnose, caused by the fungus *Collectotrichum gloeosporioides*, usually appears on lemons previously injured or held too long in storage. Also, fruit which need a higher concentration of ethylene to de-green the peel will have a higher incidence of anthracnose. Ethylene triggers the growth of the dormant fungus and it also increases the susceptibility of the rind to further invasion.

Anthracnose lesions associated with uninjured rind of de-greened fruit are initially silvery gray and leathery, and retain the same degree of firmness and elevation as the adjacent healthy rind. As the decay advances, the rind becomes brown to grayish black, and eventually a soft rot occurs. Lesions may develop on any area of the fruit surface. Lesions may also form immediately around the button where the fungus colonizes the senescent button before spreading into the adjacent healthy rind. Anthracnose lesions associated with injured rind appear as brown to reddish brown or black spots that may be firm and dry, or if sufficiently advanced, the rind becomes softened. Under humid conditions, the masses of spores on the lesion surface appear pink or salmon-coloured. The disease does not spread from infected to healthy fruit in packed containers.

Control of anthracnose is obtained by pre-harvest sprays of benomyl and postharvest dips in thiabendazole or imazalil (1000 ppm active ingredient) before de-greening, and holding the fruit at 10°C to 12°C.

Stem-end Rot

Stem-end rot, caused by the fungi *Lasiodiplodia theobromae* and *Phomopsis citri*, is widely prevalent and results in serious losses in humid growing areas such as Guyana. Fungal spores enter calyx tissues or lodge beneath the calyx at the time of flowering and remain dormant until the fruits are harvested. Symptoms appear as water-soaked spots near the stem end of the fruit, which generally turn light to dark brown. The brownish decay proceeds down the rind of the fruit. In the case of *Lasiodiplodia*, the advancing margin of the rot progresses in lobes or a finger-like pattern. The advancing margin of *Phomopsis* stem-end rot progresses evenly. Decayed tissue is initially firm, but later becomes wet and mushy and gives off a sour, fermented odour. The decay does not spread from infected to healthy fruit in packed containers.

Control of stem-end rot is obtained by pre-harvest fungicide sprays, postharvest application of imazalil (1000 ppm), and storage at 10°C. Also, a postharvest application of 2,4-D (500 ppm) helps control stem-end rot by delaying button abscission. Susceptibility to stem-end rot increases with increasing age of the fruit at harvest.

Sour Rot

Sour rot, caused by the fungus *Geotrichum citri-aurantii*, is the most objectionable and unpleasant of all the lemon decays. The organism invades the rind through injuries made by insects, mechanical injury, or other pathogens. Ripe or over-mature fruit are more susceptible to sour rot than green or immature fruit. The disease is also more severe during and after prolonged wet seasons. It is especially problematic on lemons that have been stored for long periods.

Sour rot is frequently associated with green and blue mould infections. The initial symptoms of sour rot are similar to those of the Penicillium moulds. Highly active extra-cellular enzymes produced by the sour rot fungus degrade the rind, segment walls, and juice vesicles, causing the fruit to disintegrate into a slimy, watery mass (Figure 10). Under high RH, the lesion may be covered with a yeasty, sometimes wrinkled layer of white or cream-coloured fungal growth. The fungus requires a high water content of the peel and storage at a high RH. The sour odour associated with advanced stages of disease development attracts fruit flies, which can spread the fungus to infect other injured fruit.

Figure 10. Sour rot of lemons.

Postharvest treatment with sodium *o*-phenylphenate provides some control of sour rot. Immediate storage of lemon fruit at 10°C also will delay disease development. The benzimidazole fungicides are not effective against sour rot.

Cottony Rot

Cottony rot, caused by the fungi *Sclerotinia*, is not a common postharvest citrus disease, but it can occasionally cause heavy losses of lemons. The infected area of the fruit is at first firm and brown, but subsequently the peel tissue softens and fluid is released. As the fungus grows it results in a white cottony look to the surface of the fruit. Decay spreads by contact of an infected fruit to all surrounding healthy fruit in the container.

Figure 11. Cottony rot of stored lemons.

Postharvest Disorders

Chilling Injury

Lemon fruit are susceptible to low temperature injury, commonly known as chilling injury (CI), if held at temperatures below 10°C (50°F). CI is a physiological disorder which adversely affects the appearance and quality of the fruit. Fruit symptoms include pitting and sunken lesions on the peel surface, skin discolouration, staining of the membranes separating the segments, decay, and off-flavour of the pulp. Damage is a function of temperature and time, with more CI incurred at lower temperatures and longer exposure durations. The use of pre-harvest applications of the growth regulator gibberellic acid reduces susceptibility to CI, as does maintenance of a very high RH (>95%) storage environment. Preconditioning lemons by holding the fruit at ambient temperature for several days before storing at chilling temperatures will also reduce injury. Waxing the fruit and a postharvest fungicide application will lower the amount of damage and decay from CI.

Oleocellosis

Oleocellosis, or oil spotting, is a result of mechanical damage to the peel. The outer portion of the lemon fruit contains oil glands which are rich in oil and terpenes. When the oil glands are ruptured, the oil and terpenes leak out and are toxic to the surrounding cells. This results in death of the adjacent epidermis and the formation of irregularly shaped yellow, green, or brown spots in which the oil glands of the skin stand out prominently because of slight sinking of the tissues between them. Turgid fruits are most likely to have oleocellosis because their oil glands are more easily ruptured. Fruit turgidity is greatest in the early morning and under very humid, wet conditions. Harvesting under such conditions or while dew is on the fruit should be avoided. Fruit

should be picked when the fruit surface is dry and should be handled carefully so that oil glands are not punctured or ruptured. 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. Lemons may also be left in the field overnight in their harvest container to allow the turgor pressure to decline. The lower fruit turgor pressure permits safer transport to the packing area.

Peteca

Lemons may develop large sunken areas of the rind or pits soon after packing. Peteca is a type of rind pitting in which the edges of the depressions are gently rounded. The outer layer of the rind sinks, at first without losing its normal colour, but eventually the oil glands begin to darken. Heavy brushing of the peel increases the incidence of peteca. Also, storage of lemons at 100% RH will significantly increase the amount of peteca. Although the cause of peteca is not known with certainty, it is thought that heavy oil sprays prior to harvest can increase the severity of this disorder. Lemons should not be subject to excessive brushing and should be waxed with a carnauba based wax.

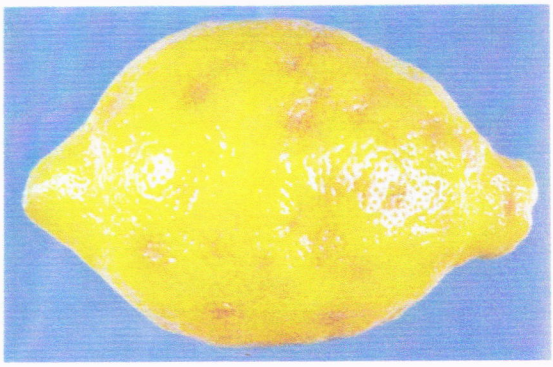

Figure 12. Peteca disorder on lemon fruit.

ANNEX I

PUBLICATIONS IN THE POSTHARVEST HANDLING TECHNICAL BULLETIN SERIES

PH Bulletin No. 1	Pineapple: Postharvest Care and Market Preparation, November 2002.
PH Bulletin No. 2	Plantain: Postharvest Care and Market Preparation, June 2003.
PH Bulletin No. 3	Mango: Postharvest Care and Market Preparation, June 2003.
PH Bulletin No. 4	Bunch Covers for Improving Plantain and Banana Peel Quality, June 2003.
PH Bulletin No. 5	Papaya: Postharvest Care and Market Preparation, June 2003.
PH Bulletin No. 6	Watermelon: Postharvest Care and Market Preparation, October 2003.
PH Bulletin No. 7	Peppers: Postharvest Care and Market Preparation, October 2003.
PH Bulletin No. 8	Oranges: Postharvest Care and Market Preparation, October 2003.
PH Bulletin No. 9	Tomato: Postharvest Care and Market Preparation, October 2003.
PH Bulletin No. 10	Okra: Postharvest Care and Market Preparation, October 2003.
PH Bulletin No. 11	Pumpkin: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 12	Lime: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 13	Grapefruit: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 14	Passion Fruit: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 15	Green Onions: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 16	Sweet Potato: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 17	Eggplant (Boulanger): Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 18	Avocado (Pear): Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 19	Bitter Melon: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 20	Bora: Postharvest Care and Market Preparation, April 2004.
PH Bulletin No. 21	Cassava: Postharvest Care and Market Preparation, April 2004.
PH Bulletin No. 22	Eddoes: Postharvest Care and Market Preparation, April 2004.

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PH Bulletin No. 29	Lemon: Postharvest Care and Market Preparation, May 2004.

OTHER PLANNED PUBLICATIONS

Starfruit: Postharvest Care and Market Preparation.

Tangerine: Postharvest Care and Market Preparation.

Yam: Postharvest Care and Market Preparation.