# IDENTIFICATION OF DISEASES, PEEL INJURIES AND BLEMISHES OF FLORIDA FRESH CITRUS FRUIT

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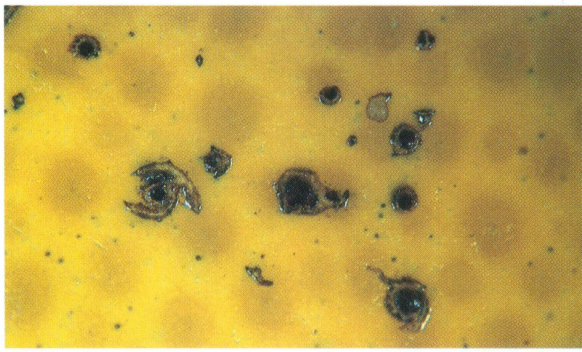
This brochure has been prepared for producers, packers and merchandisers of fresh Florida citrus to assist with the correct identification of various disorders that may be present on packed fruit. Upon identification of these disorders, appropriate measures often can be taken during production and handling to prevent or minimize their occurrence.

Disorders are classified according to causes due to fungi, physiological, pest, physical and chemical. Fungi cause surface blemishes that are usually formed by infection of immature fruit during the growing season, and decay that develops after harvest. Physiological disorders primarly impact rind appearance, with less effect on internal fruit quality. Pests can also cause injuries to immature fruit that persist and affect the appearance of the rind at maturity. Finally, physical and chemical injuries that occur during production and handling processes will impair rind quality.

However, most disorders that are cosmetic have no significant impact on eating quality.

# SURFACE BLEMISHES AND DECAY CAUSED BY FUNGI

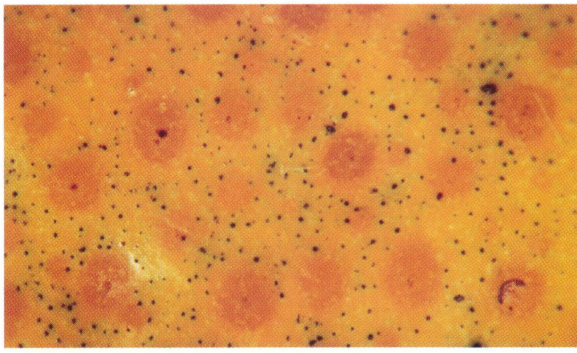


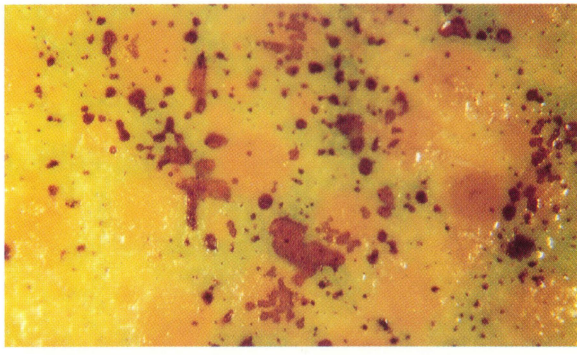
## Melanose

This blemish is characterized by scattered corky raised pustules dark brown to black in color produced by the rind in response to infection by *Diaporthe citri* (the same fungus that causes phomopsis stem-end rot). These do not lead to decay.

## Scab

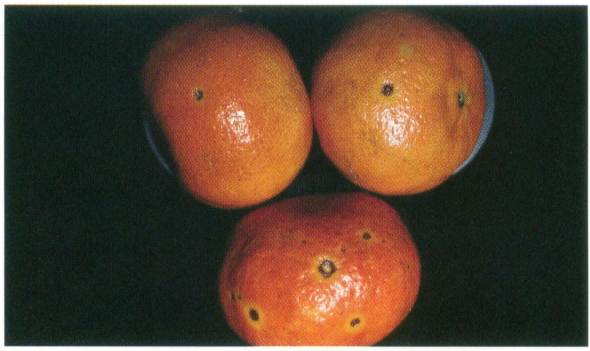
Scab appears as corky raised pustules grayish brown to black formed by the rind in response to infection by *Elsinoe fawcettii.* The pustules do not lead to decay.





## Greasy spot rind blotch

*Mycosphaerella citri* infects fruit through the stomates, natural openings of the fruit rind. Infections cause the stomates to darken, but do not cause a noticeable blemish. However, the rind may retain chlorophyll leaving it with a tinge of green. In grapefruit, the infected areas may coalesce causing a conspicuous blemish.



## Alternaria brown spot

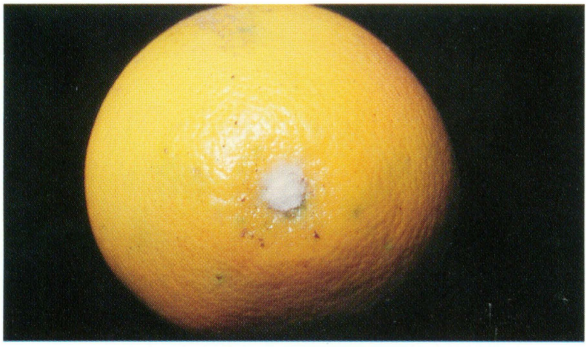
Late infections of tangerines and tangelos by *Alternaria alternata* cause corky blemishes to the rind surface. These may be dislodged leaving pock-marks that resemble hail injury, but which are much larger than melanose lesions. Occasionally, these lesions may develop into decay.

## Sooty mold

Black mycelium of *Capnodium citri* is produced on honeydew excreted on the immature fruit surface by various insects such as white fly, aphid, and mealy bug. The mycelium may not be effectively removed during washing at packing, particularly from around the button.

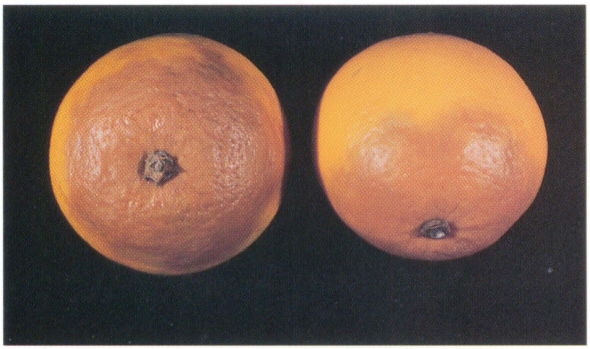
## Sooty blotch & Flyspeck

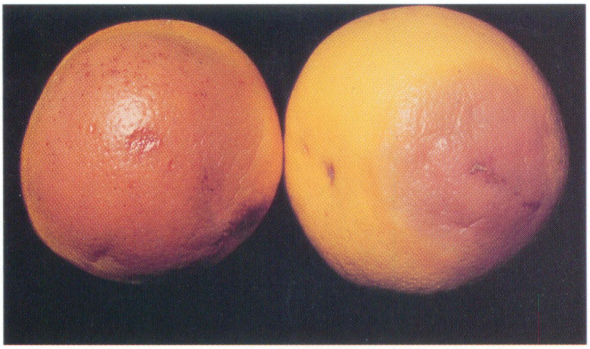
Mycelium of the fungi *Gloeodes pomigena, Stomiopeltis citri,* and *Leptothyrium pomi* (flyspeck) is firmly attached to the fruit cuticle and not normally removed by washing.



## Saprophytic growth (button)

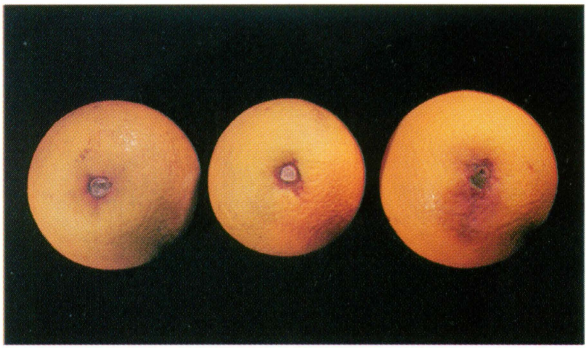
The cotton-like material found on the stem-end of stored citrus fruit results from growth of saprophytic fungi on dead button tissue. The aerial mycelium ranges in color from black to white, with various shades of gray between these two extremes. Presence of these fungi is not an indication of impending decay.

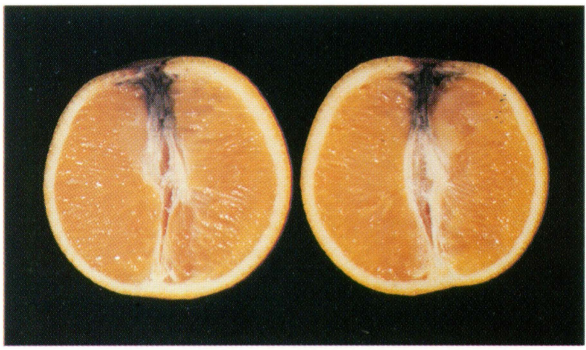




## Phomopsis stem-end rot

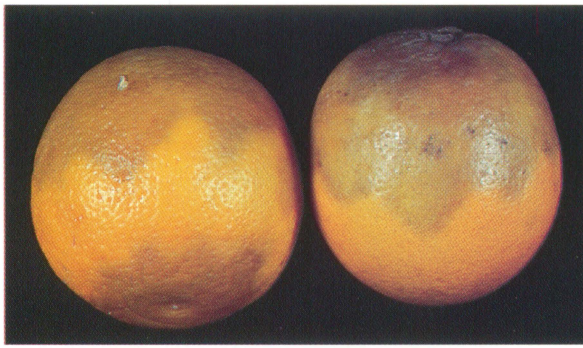
Initial infection by *Phomopsis citri* normally develops from the button at the stem-end of the fruit. The infected tissue shrinks, and a straight line of demarcation occurs at the lesion margin between diseased and healthy tissue. Decay progresses evenly through the rind and core until the entire fruit is rotten, with no spread to adjacent fruit. This type of stem-end rot is dark to light brown in color and more prevalent later in the season (January to June) in non-degreened or cold storage fruit of all types. The fungus may also develop at minor injuries to the rind, particularly during cold storage.





## Alternaria stem-end rot (Black rot)

This decay does not usually develop until after 10 weeks of cold storage. Lesions developing from infections of the button by *Alternaria citri* become light brown to black in color, and gradually progress over the fruit surface towards the stylar-end. Internal black infections of the fruit core, called black rot, are not discernable until the fruit is cut. The decay does not spread from infected to healthy fruit in packed containers.



## Diplodia stem-end rot

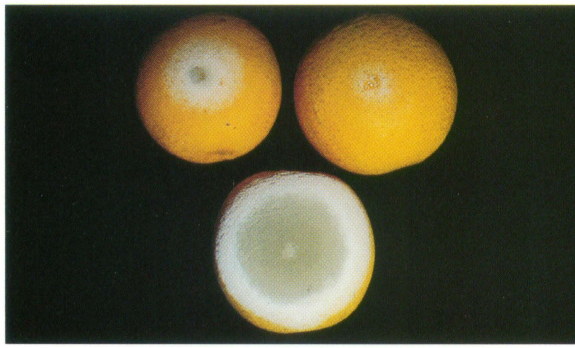
*Diplodia natalensis* usually develops from the button at the stem-end of the fruit in the rind and core. It proceeds through the core more rapidly than the rind, causing decay to appear at both ends of the fruit. *Diplodia* usually develops unevenly in the rind, forming finger-like projections of black to brown discolored tissue at the lesion margin between the segments. The decay does not spread from infected to healthy fruit in packed containers. Degreening with ethylene promotes development of the disease and thus it is more frequent on early-season degreened fruit of all types.

## Brown rot

Lesions caused by *Phytophthora citrophthora, P. nicotianae* or *P. palmivora* may occur on any area of the fruit surface and are light brown in color, firm and leathery, and remain at the same elevation as the adjacent healthy rind. Under humid conditions, white mycelium may form on the rind surface. The disease has a characteristic pungent, rancid odor. The decay spreads in packed containers from infected to healthy fruit.

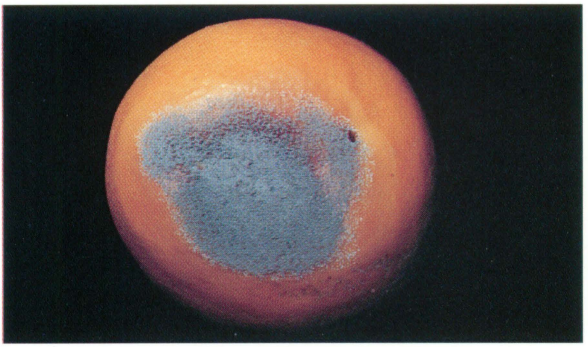
## Anthracnose

Anthracnose caused by *Colletotrichum gloeosporioides* is stimulated by ethylene degreening of early season Robinson, Sunburst, and Fallglo tangerines, navel and Ambersweet oranges, and grapefruit from September through November. The lesions initially appear silvery gray and leathery, and are similar in firmness and elevation to adjacent healthy rind. The rind becomes brown to grayish black and softens as the rot progresses. Pink masses of spores may form on the lesion surface in humid environments. Lesions may be tear-dropped in shape due to distribution of the spores at the time of infection. Anthracnose may also develop at rind injuries to any type of fruit producing firm, sunken dry lesions. When advanced, the lesions become soft. Infections do not spread to adjacent healthy fruit.



## Green mold

*Penicillium digitatum* can develop in all fruit types at injuries to the rind, even very minor ones such as those associated with oleocellosis. The initial decay appears as a soft watery spot that is more firm than comparable stages of sour rot. White mycelium on the fruit surface soon produces millions of olive green spores that are easily dispersed during handling. The decay spreads occasionally from infected to healthy fruit in containers, but masses of spores produced on infected fruit can contaminate surfaces of healthy fruit with the green-colored spores. Fungicides that inhibit sporulation of *P. digitatum* leave the fruit white in color from the surface mycelium.



## Blue mold

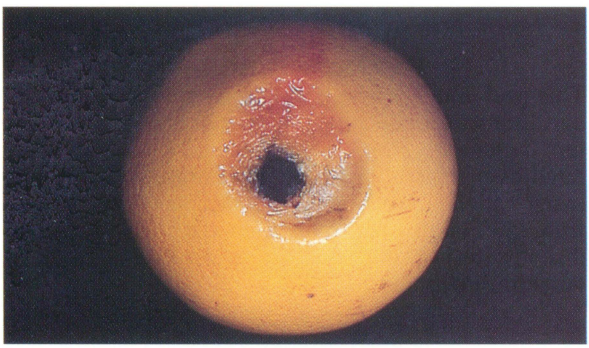
Blue mold caused by *Penicillium italicum* infects through injuries like green mold. Initial lesions appear similar to lesions of green mold and sour rot, but are more firm than sour rot. Sporulation is blue in color surrounded by a narrow band of white mycelium encompassed by water-soaked rind. The decay is usually of minor importance, but since it grows better at lower temperatures than green mold, it may predominate over green mold in fruit held in cold storage. Blue mold spreads in packed containers and may cause a nest of diseased fruit.

## Whisker mold

Whisker mold caused by *Penicillium ulaiense* usually occurs during storage in lesions of green or blue mold. It is rarely observed as the primary causal rot, and it does not affect adjacent healthy fruit. The name is derived from conspicuous white often sterile stalk-like coremia produced in the lesion. When lacking coremia, often at early stages of decay, the symptoms appear similar to blue mold.

## Sour rot

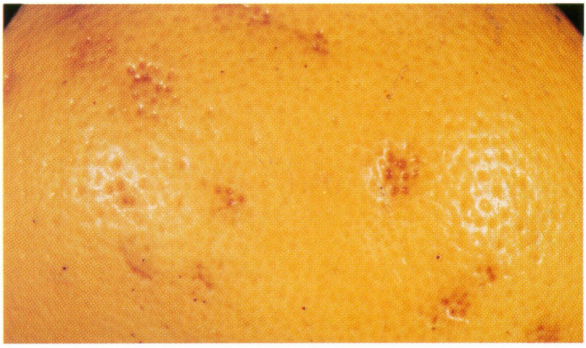
Sour rot caused by *Geotrichum candidum* is more prevalent on tangerines, tangelos, navel and Temple oranges, and late-season grapefruit. Infections occur only at more severe injuries, such as plugs or deep punctures, and first appear as water-soaked, light to dark yellow, slightly raised spots. At high humidities, yeast-like wrinkled white or cream-colored mycelium appears on the lesion surface. Lesions are very mushy, and decayed fruit disintegrate into a slimy, watery mass attractive to fruit flies. Infection can spread by contact causing pockets of decay in packed containers.



## Aspergillus rot

Aspergillus rot caused primarily by *Aspergillus niger* is a minor decay that usually occurs when fruit are held in storage at high temperatures. The decay is light-colored, very soft, and easily punctured, somewhat like sour rot. The lesion surface is sunken, with a distinct demarcation between diseased and healthy tissue, and eventually covered with a black, powdery layer of spores.

# PHYSIOLOGICAL DISORDERS

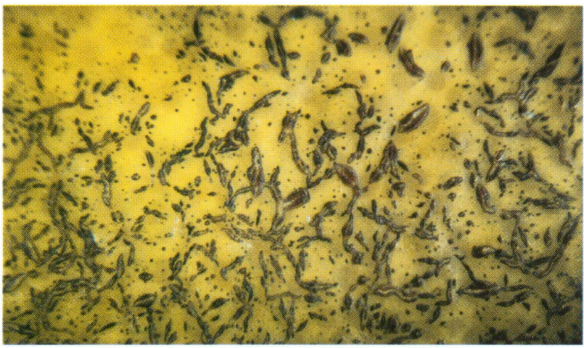


## Postharvest pitting

This peel injury is triggered by high temperature storage after wax application and is characterized by clusters (commonly 5 to 20) of collapsed oil glands scattered over the fruit surface. It has been observed in many varieties, but is most prevalent on white grapefruit and Fallglo tangerines where collapsed regions discolor (brown/bronze in grapefruit; brown/black in tangerine) with time.

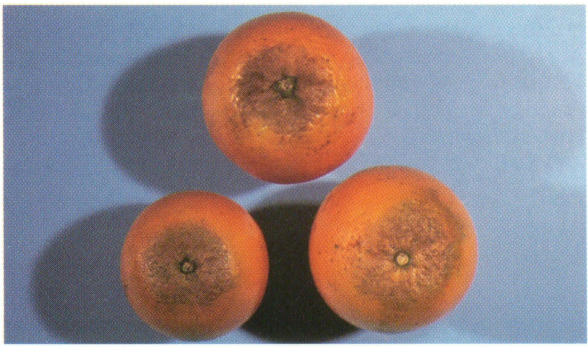
## Chilling injury

Chilling injury is a collapse of discrete areas of the rind of grapefruit that develops after at least one month of storage at temperatures below 50-60°F. Other symptoms may be manifested as a discolored scald or water-soaked area of the rind. Grapefruit are most susceptible during the early and late months of the harvesting season.



## Stylar-end russetting

This disorder is a blemish of the rind around the stylar-end of the fruit formed by a checkered network of disrupted epidermal and cuticular tissue. It is most commonly observed on navel and Hamlin oranges.



## Aging

Aging is a blemish of the rind at the stem-end of the fruit that may occur as it reaches full maturity. The concentric cracks and tissue around the button may darken prematurely, particularly in Valencia oranges.

## Stem-end rind breakdown

This disorder is caused by dehydration of the rind around the stem-end of the fruit that leads to darkening and collapse of the surface cells. Cells close to the button usually remain normal. Stem-end rind breakdown occurs more extensively on small, thin-skinned fruit when excessive moisture is lost, normally between harvesting and application of wax during packing.

## Creasing

Creasing is a collapse of the flavedo into irregular grooves over the fruit surface caused by deterioration of cells of the underlying albedo. Creasing is usually more prevalent on thin-skinned, fully mature fruit. Creased fruit generally exhibit poor keeping quality because affected areas often split during handling thus providing injuries that allow entry of decay pathogens.

## Boron deficiency

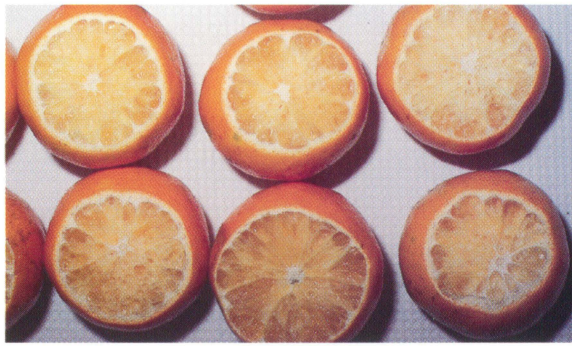
Boron deficiency is manifested by thickened regions (bumps) and small pockets of brownish gum in the fruit rind.

## Blue albedo

Blue albedo is a disorder of the albedo (white portion of the rind) where vascular bundles and surrounding tissue are stained with a blue pigment. The non-toxic, naturally formed material is a water-soluble anthocyanin. It occurs most frequently in grapefruit, and has been associated with fruit from trees grown under poor water drainage.

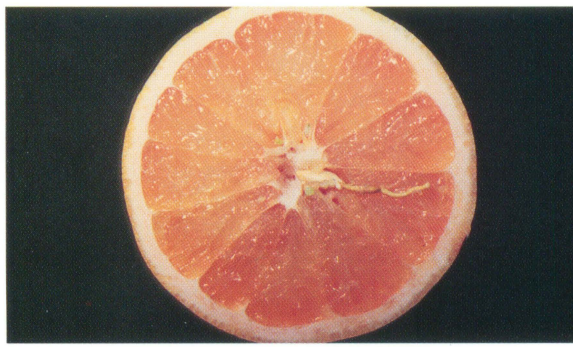
## Blossom-end clearing

This peel injury occurs primarily in thin-skinned, fully mature, seedless grapefruit in late season. The disorder develops when handling at harvest and packing causes the rupture of juice vesicles and leakage of juice into the central fruit cavity. The juice causes a soaked area to develop, primarily at the fruit stylar-end, which is susceptible to infection by decay fungi.



## Internal drying

A disorder manifested by collapse, drying and granulation of juice vesicles and segments. It may occur more frequently as cultivars approach full maturity or from exposure of mature fruit to freezing field temperatures. The disorder often occurs more frequently at the stem-end of the fruit.



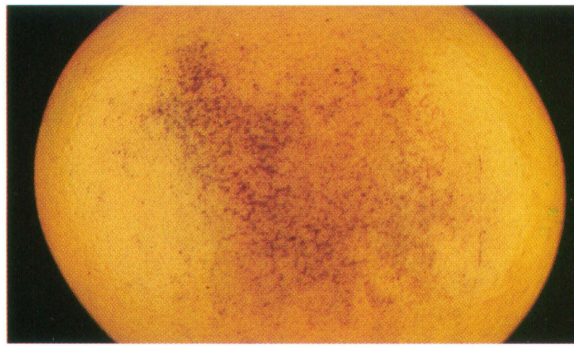
## Seed germination

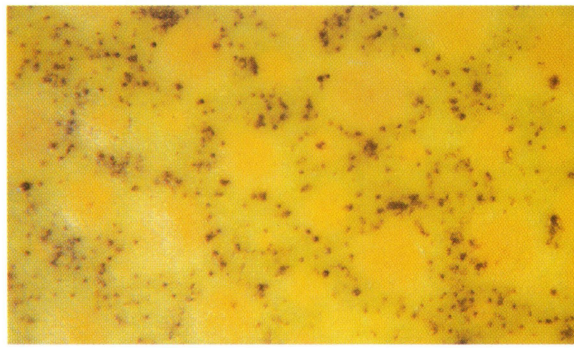
Seeds may germinate in fruit as it reaches full maturity, and continue to germinate during storage above 50°F. Some off-flavors are usually associated with seed germination. The problem is most common in grapefruit.

## Zebra-skin

Zebra-skin is a peel injury that occurs primarily with early season tangerines degreened with ethylene. Fruit are particularly sensitive to brushing during washing and subsequent handling on the packing-line. Affected necrotic areas of the rind usually develop at the highest points of the fruit surface over the center of the underlying segments. Tangerines are particularly susceptible to this disorder when harvested after heavy rain or irrigation preceded by drought.

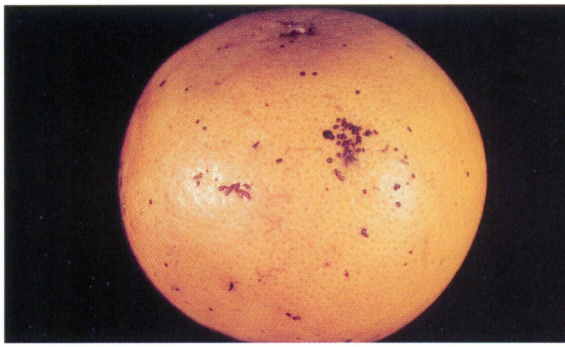
# SURFACE BLEMISHES CAUSED BY PESTS

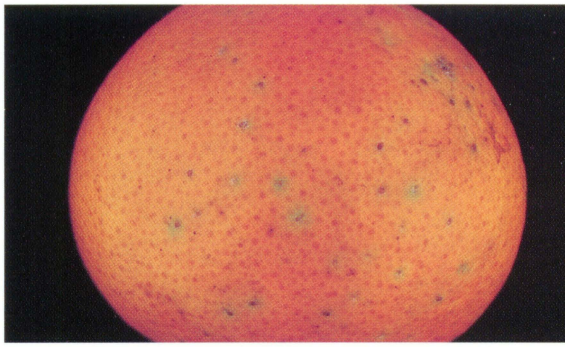




## Rust mite

Feeding injury of citrus rust mite (*Phyllocoptruta oleivora*) during late season produces smooth russet-colored blemishes (bronzing) on the fruit surface, sometimes in a tear stain pattern. Damage can occur over the oil glands, but on grapefruit, it occurs primarily between the glands.





## Scale insects

Armored scales, such as purple (*Lepidosaphes beckii*) and chaff scale (*Parlatoria pergandii*), may remain on fruit after washing. If removed, the damaged areas may appear as green spots on the fruit surface, particularly on tangerines.

## Thrips

Damage by thrips (*Chaetanaphothrips orchidii, Heliothrips haemorrhoidalis*) characterized by a brown ring of rough or smooth russeted rind is commonly observed on grapefruit at contact points between clusters of fruit during growth. Rust mites also contribute to this disorder.

## Mealy bug

Damage around the button is caused by feeding of mealy bug (*Planococcus citri*) on immature fruit.

## Leafminer

Larvae of leafminer (*Phyllocnistis citrella*) burrow under the epidermis of the fruit rind of immature fruit causing characteristic lesions at maturity.

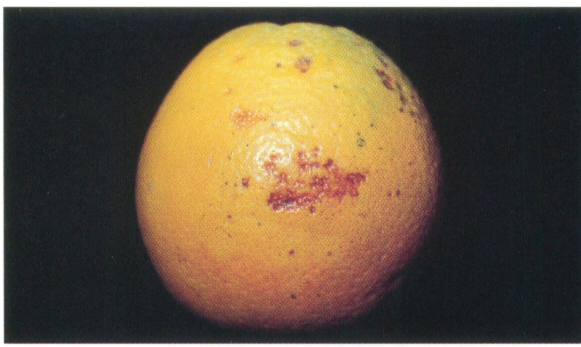
## Grasshoppers and Katydids

Feeding damage by grasshoppers (*Schistocerca americana*) and katydids (*Microcentrum rhombifolium*) to the rind of immature fruit causes a smooth shallow injury covered with scar tissue at fruit maturity.

# SURFACE BLEMISHES CAUSED BY PHYSICAL AND CHEMICAL INJURY

## Wind scar

Injury from wind occurs frequently to young fruit during the first 3 weeks after petal fall when leaves, twigs, or thorns rub against the rind. Scarring is less frequent after fruit are 12 weeks of age. Areas of the fruit surface affected by wind scar expand as the fruit enlarges during growth.

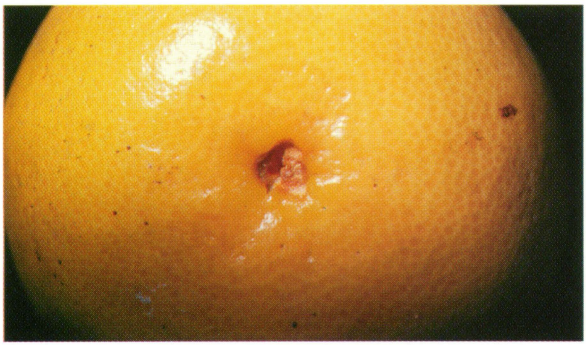


## Physical damage

Damage in the form of small injuries to the rind surface is caused by sand particles or equipment during harvesting and/or handling at packing. The injury is characterized by wound periderm formed during healing. Areas do not expand or spread during storage.

## Oleocellosis (oil spotting)

All types of citrus may develop oleocellosis, but lemons and navel oranges are particularly vulnerable. Upon physical injury, peel oil released from oil glands in the rind is phytotoxic and causes necrosis and collapse of surrounding healthy epidermal cells. These cells remain green following degreening and later become darkened. Oleocellosis is enhanced by foggy, wet weather that increases fruit turgidity and its susceptibility to injury during harvest.

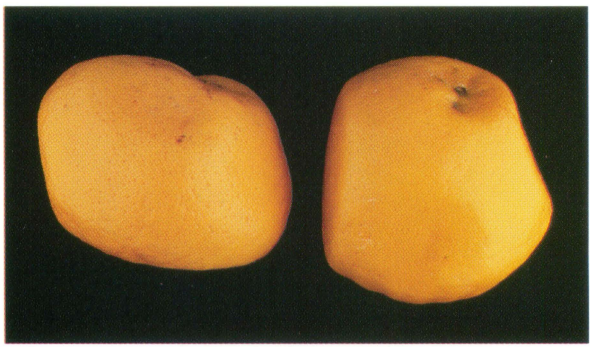


## Plugging

Plugging is the removal of a portion of the rind with the button during harvesting. This provides a site for entrance of fungi causing green mold and sour rot.

## Punctures

Punctures may occur to the rind of fruit from thorns or twigs in the tree canopy and at harvest from clipped fruit when the stems are not cut closely to the sepal at the button.

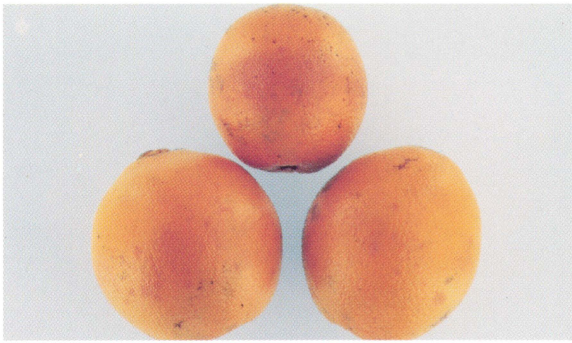


## Deformation

Deformation of fruit after packing is enhanced by rough handling during harvest, dehydration, and/or overpacking.

## Brush-burn

Damage of the rind may occur from washer or polisher-brushes during fruit washing and/or drying processes. The damage occurs most frequently at the equator where fruit spin on the brushes.



## SOPP injury

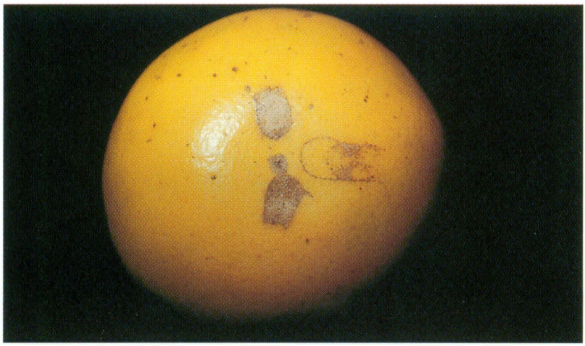
Injury may occur to the fruit surface from lengthy exposure to the fungicide sodium orthophenylphenate (SOPP), or from normal exposure after physical damage, such as brush injury during washing.

## Color-add

An intense red stain may occur at injured areas of the rind surface or at the button site from treating oranges and tangelos with Citrus Red No. 2, a dye used to enhance the orange color of early-season degreened fruit.

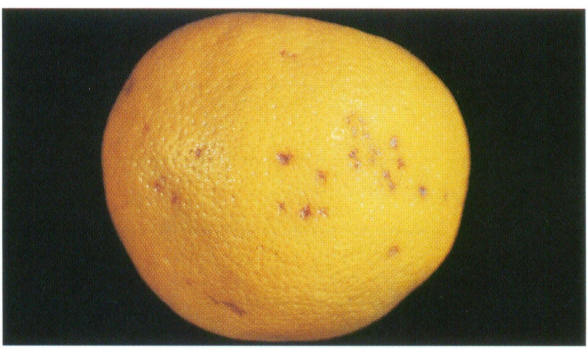
## Chalking

Chalking is a white deposit formed by resolubilization of the water wax by condensation of water on the fruit surface which often occurs after removal of fruit from cold storage to higher temperatures.



## Spray burn

The rind can be damaged with various nutritional and pesticide field sprays under certain environmental or application conditions. Burns may appear in tear-stain patterns down the side of the fruit and/or at the stylar-end due to the accumulation of the spray. Applications of some postharvest treatments may cause injury in ring patterns at points of fruit contact in containers.



## Methyl bromide (fumigation)

**(Courtesy M. A. Ismail)**

Injuries to the rind following fumigation may be extensive when methyl bromide is applied to fruit at temperatures less than 50°F or to fruit wet with condensed water.

# NOTES

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100% PURE
FLORIDA