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## PACKINGHOUSE NEWSLETTER

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### CONTROL OF GREEN MOLD AND SOUR ROT CAUSED BY *PENICILLIUM* AND *GEOTRICHUM*, THE TWO MAJOR WOUND PATHOGENS OF FLORIDA CITRUS FRUIT

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Based on our observations and the calls we are receiving from the industry, there appears to be potential this season for the development of a significant amount of green mold and sour rot which are caused by two fungi that require peel injuries for infection.

Due to the heavy crop load on many varieties this season, there may be more than the normal number of dropped fruit on the ground in some groves. These fruit are frequently infected by *Penicillium* and *Geotrichum*, and spores are disseminated from decayed fruit surfaces to healthy fruit in the tree canopy by wind and water splash. Injuries to healthy fruit that occur during harvest therefore risk a greater probability of infection due to high spore loads on the fruit surfaces. Also, the warm winter temperatures favor growth of *Geotrichum* and the foggy high humidity days enhance fruit turgidity and peel moisture which benefit sour rot development.

Finally, the occurrence of fungicide resistant strains of *Penicillium* may be more frequent this season because of the slow market. Fungicide treated packed fruit are being held in the packinghouse in many instances for several days to a week before shipment. This allows time for a resistant strain of *Penicillium* to infect and sporulate in the house. One infected fruit can produce up to 100,000,000 spores that may be released into the packinghouse atmosphere with the potential to infect and decay fruit in spite of fungicide treatment.

Measures should be taken to minimize the development of these two decays and to monitor levels of fungicide resistant *Penicillium* during the rest of the season. Since injuries are required for infection, it is obvious that fruit should be harvested and transported carefully and without soil contact. Harvest may have to be delayed until later in the day when fruit are less turgid and prone to breakage of oil glands (oleocellosis) and blossom-end clearing. Fungicides should be applied no later than 24 hours after harvest. Consider using SOPP (sodium orthophenylphenate) in the washing process because it is the only fungicide with activity against sour rot. The material also helps to keep the washer brushes sanitary and minimizes spread of decay from infected to healthy fruit. SOPP is also useful to combat strains of *Penicillium* with

resistance to thiabendazole (TBZ). Imazalil is an effective fungicide for green mold control and it tends to be less prone than TBZ to development of resistance by *Penicillium*. Aqueous applications of imazalil are more effective against green mold than wax applications, and rates of 2000 ppm or higher provide better sporulation control than the 1000 ppm rate. This would be useful to minimize sporulation on packed fruit.

Good sanitary practices are of utmost importance to aid in the control of sour rot and green mold and for suppression of fungicide resistant strains of *Penicillium*. The packinghouse and equipment should be cleaned nightly to remove all debris and fruit. Sanitary sprays of chlorine or quaternary ammonium compounds should be applied to equipment and handling facilities **only after** surfaces have been hosed down with water and detergent. Dirt and debris inactivate sanitizing compounds before they have an opportunity to kill fungal spores. Decayed packed fruit should **never** be repacked in the packinghouse facility because, in all probability, much of the decay will be caused by fungicide resistant *Penicillium*. The repacking process would release large numbers of these spores into the packinghouse environment. Finally, if packed fruit can not be shipped after one or two days, it should be held under refrigerated storage at high relative humidity. Lower than ambient temperatures help to retard lesion development and fungal sporulation.

#### THE HIDDEN CAUSES OF FRUIT LOSSES IN A CITRUS PACKINGHOUSE

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Physical injury to citrus fruit during harvesting, hauling, and packing is one of the main causes of fruit losses due to decay. It provides ports of entry for decay causing organisms and may result in excessive decay during transit.

To reduce physical injury to citrus fruit, a careful and accurate assessment of various steps involved in harvesting, hauling, degreening, dumping, washing and drying of fruit is essential in order to eliminate those conditions that could result in fruit injury. Effective grading is important in eliminating severely injured fruit from the final pack. However, minor injuries can go undetected and become infected with fungal spores, even after the application of fungicides.

A simple method to detect physical injuries to fruit in the packinghouse is one that uses a colorless solution of 2,3,5-triphenyltetrazolium chloride, simply known as TTC. Minor peel injuries turn red when they come in contact with TTC making them readily visible to the naked eye. This test can help identify areas on the packingline where fruit are being injured and assist in evaluating packingline changes to reduce fruit injuries. The following is a brief description of the procedure.

Using goggles and gloves for eye and hand protection, prepare a 0.5% solution of TTC in tap water by dissolving approximately 19 grams (13 level teaspoons) of the powdered compound in a gallon of water. Collect samples of fruit at various points on the line (six grapefruit or 12 oranges or tangerines are usually adequate). Samples may be taken from a bin before dumping and after dumping; others may be collected before and after washing, before and after fungicide or wax applications.

Dip fruit in a dishpan containing the TTC solution. Keep fruit half submerged for 30 minutes. Pour the TTC back into the jug through a layer of cheese cloth to remove debris. Add fresh tap water to the fruit and keep them submerged for 5 minutes. Wearing protective hand gloves, transfer fruit to a double layer of heavy paper bags and keep at room temperature overnight.

Examine the fruit and grade the degree of damage as slight, moderate or severe. Based on the results of the TTC test and the extent of the damage detected at each sampling point, necessary adjustments in the line components are made to minimize physical injury. This should improve quality of fruit arrival and enhance consumer acceptance.

The following are some of the changes which will help reduce physical injury to fruit in the packinghouse.

1. Minimize trash and sand by close monitoring of harvesting operation.
2. Avoid overfilling of incoming pallet boxes or harvesting containers.
3. Facilitate fruit movement after dumping and avoid surges in fruit flow.
4. Maximize trash elimination through the use of a sloping belt or a metal rod spaced section.
5. Use pregraders immediately after dumping to clip off stems from fruit and to remove rots and split fruit.
6. Check and remove any stems or twigs caught in the packingline. Inspect the line several times daily.
7. Optimize brushing time and brush speed. Brush speeds over 120 rpm for washers and 100 rpm for fungicide and wax applicators should be carefully evaluated for benefit vs. damage to fruit.
8. Eliminate brushes with stiff bristles and use wipeout devices. Fruit with tiny brush scratches on the surface of the flavedo are more susceptible to chemical injury, excess heat and shrivelling due to weight loss.
9. Condition new brushes, particularly those used on tangerine packinglines. A plywood sheet lightly touching the rotating brushes for 1 to 2 hours is effective in conditioning new brushes. Prewetting fruit prior to brushing is essential to reduce brush damage. Also, installation of new brushes may be delayed until a midseason break when the fruit peel is more mature.
10. Minimize fruit drop and right angle turns and improve fruit flow.
11. Reduce friction between fruit and shears through design and material selection.
12. Eliminate or minimize fruit rubbing against the sides of drying tunnels or other conveyors.
13. Avoid overfilling of cartons.

Finally, use the TTC injury detection test at least twice a year on fruit from various segments of your packinghouse machinery, especially when new or delicate fruit are about to be packed. Results of each test should be filed for future reference and comparison.

#### AVAILABLE PUBLICATIONS

Available from Dr. W. Wardowski, CREC, 700 Experiment Station Road, Lake Alfred, Florida 33850

Activities of sucrose metabolising enzymes during sucrose accumulation in developing acid limes, by Ed Echeverria. 1992. *Plant Science*. 85 (1992) 125-129.

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