UNIVERSITY OF FLORIDA | Cooperative Extension Service
Institute of Food and Agricultural Sciences

PACKINGHOUSE NEWSLETTER

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Packinghouse Newsletter No. 184
December 21, 1998

Key Index Words: Postharvest Pitting

REDUCING POSTHARVEST PITTING INCIDENCE OF CITRUS FRUIT

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Introduction. Postharvest pitting was identified as a citrus peel disorder in white grapefruit in the Spring of 1994. The disorder is characterized by scattered clusters of collapsed oil glands that darken with time. We know that pitting is triggered by high temperature storage of waxed fruit. We also know that factors not related to postharvest handling influence pitting incidence. In this newsletter, we discuss several approaches by which pitting can be reduced.

(1) Cold storage. In our studies, cold storage has provided the most consistent control of pitting regardless of variety, time of season, or fruit susceptibility. The question often asked by packers and shippers about storage temperature is: How low and how fast? The general answer is: Go as low as you dare and as fast as you can after wax application. In some cases, we have observed that delaying cold temperature storage by as little as 24 hours can reduce the effectiveness of refrigeration.

Rapid cooling, such as that provided by forced air cooling systems, is important. As a guideline, 40°F within 6 hours after waxing would be most effective. However, there are several problems with low temperature storage:

- First, refrigeration is costly. Cold storage requires storage rooms, a cooling system, and electricity to run the cooling system.

- Second, cold storage may lead to chilling injury. Studies over the past several decades have shown that wax and fungicide applications reduce chilling injury. However, the effectiveness of these treatments in long-term, large-scale evaluations have not been fully assessed. Consequently, concerns about chilling injury persist.

- Third, the logistics of cold storage may be complicated. Cold storage should be maintained throughout the market chain. Susceptible fruit such as Fallglo seem to be particularly sensitive to increases in temperature during marketing.

Despite these problems, cold storage is currently the best method for controlling postharvest pitting. Additionally, cold storage typically reduces decay and some other peel disorders, controls weight loss, and tends to maintain flavor.

(2) Wax application. High shine shellac- and/or wood resin-based waxes create a mirror like finish on the fruit surface that mask physical imperfections. Unfortunately, these high shine waxes tend to have poor gas exchange characteristics. This leads to an accumulation of organic compounds such as alcohols and aldehydes that impart a fermented or "old fruit" taste. The reduction in gas exchange also leads to reduced internal oxygen levels that inhibit natural degreening of some tangerines such as Fallglo. Perhaps more importantly, poor gas exchange imparted by high shine waxes stimulates postharvest pitting. Application of more gas permeable waxes such as some carnauba- and polyethylene-based waxes may greatly reduce postharvest pitting incidence. However, there are several problems with using waxes with higher gas permeabilities:

- First, waxes that are more gas permeable tend to shine less.

- Second, pitting may be only reduced, but not eliminated by waxes with higher gas permeabilities. This is particularly true when fruit undergo long-term storage at high temperatures.

- Third, late season fruit do not consistently respond well to the alternative wax formulations. We have observed in some cases that severe pitting occurs in late season fruit regardless of wax formulation.

The advantages of using waxes with higher gas permeabilities may outweigh the disadvantages, particularly in cases where internal quality is important. A good example of this is specialty citrus in which off-flavors more readily alter fresh flavor.

As an alternative to changing wax formulation, gas exchange of fruit coated with high shine waxes may be facilitated by creating avenues of high gas permeability. We have found that preventing wax from covering small areas of the fruit or removing wax after it has been applied reduces pitting. As a more extreme alternative, we have found that perforating the fruit cuticle with small holes after wax application also reduces pitting. The highly permeable area needed for gas exchange of fruit is relatively small (less than 5% of the total area).

(3) Production practices. Pitting incidence is variable despite similar postharvest handling. Our experiments show that time of season and grove site influence susceptibility. We know considerably

less about the nature of preharvest susceptibility than we do about the influence of postharvest stress. With respect to susceptibility, we know that:

(A) Larger fruit are more susceptible to pitting than smaller. This may result from the relative decrease in surface area with increase in fruit volume resulting in lower oxygen levels.

(B) Fruit from trees treated with gibberellic acid (GA) tend to be less susceptible than fruit from non-treated trees.

(C) Maturity has no clear effect although very late season fruit tend to be more susceptible than fruit harvested at any other time.

(D) Susceptibility within a grove is in part related to location and may be related to height of the water table. Nutrition and water relations may play critical roles in determining the extent to which fruit pit.

Future.

For the immediate future, pitting incidence can be reduced by using cold storage and more gas permeable waxes. The combination of cold storage and more gas permeable waxes reportedly improved commercial arrivals of Fallglo tangerine this fall. However, the inherent disadvantages of these treatments, such as those listed above, suggest that additional studies on the relationship between pitting and citrus peel physiology are necessary in finding the cause and control of susceptibility.

For the more distant future, studies on the effects of water relations, nutrition, and growth regulators are necessary to find clues that could lead to finding cultural practices that reduce susceptibility. Perhaps more importantly, basic studies on peel biochemistry, particularly those that specifically focus on the events immediately prior to and during oil gland collapse, are essential to determining the primary cause of pitting.

1999 FLORIDA POSTHARVEST HORTICULTURE INSTITUTE AND INDUSTRY TOUR

The 8th annual Florida Postharvest Horticulture Institute and Industry Tour is scheduled March 8 in Gainesville and March 9-12, 1999 for the tour. The deadline for early registration is February 19, 1999.

The meeting is designed for produce industry professionals, educators and students. The theme will be Innovations in Produce Packaging Technology.

For more information contact Abbie Fox, Institute Facilitator, phone 352 392-1928 extension 235, fax 352 392-5653.e-mail ajfox@gnv.ifas.ufl.edu.

THIRTY-EIGHTH ANNUAL CITRUS PACKINGHOUSE DAY
THURSDAY, AUGUST 19, 1999
CITRUS RESEARCH AND EDUCATION CENTER
700 EXPERIMENT STATION ROAD
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AVAILABLE PUBLICATIONS

Available from Dr. W. F. Wardowski, Citrus REC, 700 Experiment Station Road, Lake Alfred, Florida 33850

Pitting of Grapefruit That Resembles Chilling Injury, by P. D. Petracek, W. F. Wardowski, and G. E. Brown. 1995. HortScience 30:1422-1426.

Preharvest Effects on Postharvest Pitting of White Grapefruit, by P. D. Petracek and C. Davis. 1996. Proc. Fla. State Hort. Soc. 109:251-254.

Identification of Posthavest Pitting of Citrus Fruit, by P. D. Petracek, C. Davis, and H. Dou. 1997. Florida Department of Citrus, Lakeland, Fla.

A Postharvest Pitting of Temple Oranges Stimulated by High Temperature Storage and Wax Application, by P. D. Petracek, H. Dou, and I. Malik. 1997. Proc. Fla. State Hort. Soc. 110:211-214.

Postharvest Pitting of 'Fallglo' Tangerine, by P. D. Petracek, L. Montalvo, H. Dou, and C. Davis. 1998. J. Amer. Soc. Hort. Sci. 123:130-135.

Influence of Applied Waxes on Postharvest Physiological Behavior and Pitting of White Grapefruit, by P. D. Petracek, H. Dou, and S. Pao. 1998. Postharvest Biol. Technol. 14:99-106.

Enhanced Activity of Abscission Enzymes Predisposes Oranges to Invasion by Diplodia natalensis during ethylene degreening, by G. E. Brown and J. K. Burns. 1998. Postharvest Biol. Technol. 14:217-227.