

## **Etiology and Management of Rind Breakdown of Mandarins**

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Recent reports of preharvest rind decay of mandarins included cases with severe crop losses in some citrus growing areas of California (Butte, Fresno, Tulare, and Kern Co.). The damage generally occurred shortly after rainfalls and was most severe on Satsuma mandarins. Symptoms were more frequently observed on fruit on the outer perimeter of the tree and on the exposed side of the fruit.

Some researchers have associated the problem with fungi such as *Alternaria* species. Our fungal isolations from affected fruit, however, were inconsistent with isolations of fungal species in the genera *Alternaria*, *Fusarium*, *Macrophomina*, *Ulocladium*, and *Cladosporium*. All these organisms are either common epiphytic fungi or fungi associated with wind-borne soil deposits on plant tissue.

Re-inoculation of fruit with the isolated fungi only sometimes reproduced disease symptoms and only on water-soaked fruit. Furthermore, in preliminary field trials that were conducted in Butte Co. in the fall of 2002-03, fungicide treatments that included thiophanate-methyl (Topsin-M), pyraclostrobin/boscalid (Pristine), and azoxystrobin (Abound) only reduced the incidence of disease from 99% in the control to approximately 90%. These data suggested that mandarin rind breakdown is a physiological, abiotic disorder of fruit rather than a pathological problem caused by fungi or other organisms.

In reviewing the citrus literature, we found that rind breakdown of citrus was reported by Fawcett and others in the 1930s. Wet weather combined with a sudden decrease in temperature was shown to result in liberation of rind oil and collapse of cells just under the cuticle. In our laboratory studies with Satsuma mandarins, fruit were soaked in water for 6 hours at 15, 20, 25, 30, or 35 C. After one day, similar lesions developed to those observed in the field at all temperatures with slightly more at temperatures greater than 20 C.

When fruit were first treated with postharvest fruit coatings prior to water soaking, the incidence and severity of the disorder was significantly reduced. Similar results were obtained with four applications of an agricultural anti-transpirant (e.g., Vapor-Gard) or a summer oil (e.g., Omni Supreme spray oil) in a field trial in the fall of 2003 (Fig. 2A), whereas the fungicides Abound and Topsin-M only slightly decreased the incidence of the rind disorder.

Field trials were again conducted in the fall of 2004 in Butte (2 trials) and Fresno Co. (1 trial). In two trials where fungicide treatments were done, these treatments were ineffective. In all trials one to two applications of Vapor-Gard or Omni oil significantly reduced the disorder (Fig. 2B).

When trees were protected from rainfall using a tent, in both 2003 and 2004, the disorder could not be detected. Furthermore, using a growth regulator (gibberellic acid) the incidence of rind breakdown was also significantly reduced as compared to untreated trees, but this treatment kept fruit immature and delayed harvest by approximately one month.

In summary, results from our trials are indicating that mandarin rind disorder is an abiotic, weather-related problem of mature fruit that has undergone a green to orange color change. In addition, we

developed economical treatments that can significantly and dramatically reduce the disorder by preventing water saturation of the rind or by delaying maturity and allowing maturation of the rind. Additional field trials are ongoing to optimize treatment timings.

*Contact Citrus Research Board for figures.*