

# Chemical Freeze Protection of Citrus 1989/1990

*Marvin Butler, University of Arizona Extension Agent, Yuma  
Paul Brown, Biometeorologist, Tucson*

## ***Abstract***

*Three chemical frost protectants were applied to Lisbon lemons using a hand gun operated from a John Bean sprayer. Leaf samples were placed in test tubes with 10 ml of distilled water to determine the temperature at which they froze using a constant temperature bath. Although the sample size was increased by 50 percent over the previous year, the treatments were not significantly different from the untreated.*

## **Introduction**

Research has been conducted at the Yuma Mesa Agricultural Center each winter since 1984/1985 to determine the effectiveness of chemical freeze protectant materials to protect citrus from freeze damage. These materials included copper-based fungicides, trace mineral sprays, urea-based materials, polymers and blends specifically formulated as freeze protectants. Laboratory studies have shown that these types of materials can kill or prevent ice-nucleation-active (INA) bacteria from acting as a nucleating agent around which ice formation is initiated. Without the presence of these nucleators, plants have been shown to tolerate colder temperatures without experiencing damage to plant tissue.

The research on citrus in Yuma was conducted on Lisbon lemons, with several application and evaluation procedures used through the years. Despite attempts to reduce variability and refine procedures, the results remained inconclusive and it was not possible to show consistent differences between any of the treatments and the untreated control trees.

## **Methods and Materials**

The 1989/1990 evaluations were conducted on fifteen-year-old Lisbon lemons on rough lemon rootstock located at the Yuma Mesa Agricultural Center. Three materials, Unocal Plus, Frostgard, and Kocide 101, were applied to two-tree plots replicated four times in a randomized complete block design using a handgun operated from a John Bean type sprayer. As shown in Table 1, applications followed manufacturer recommended rates in 300 gallons of water per acre. Untreated control trees were identified near each of the pair of treated trees as a standard against which the treated trees could be compared.

Applications and evaluations were made for each of the treatments on successive days so samples for each treatment could be compared alone against the corresponding untreated trees. This allowed the number of samples to be increased, providing a more favorable climate to determine statistical differences. Twelve full-sized, new leaves were taken from each tree, providing a total of 24 leaf samples per plot, or 96 samples per treatment. Samples were evaluated on the second and eighth day after application.

Test tubes containing 10 ml of distilled water were prescreened to insure no nucleating agents were present by placing them in a cold bath at -8°C for thirty minutes. Any test tubes in which the water spontaneously

froze were discarded. A leaf sample was placed in each of the test tubes which were randomized in the trays before being placed in the Neslab Exacol EX-410 constant temperature bath. It was outfitted with a digital controller accurate to  $\pm 0.1^{\circ}\text{C}$  and EN-850 flow through cooler. An ethanol solution was used in the bath to prevent freezing of the equipment. Leaf samples were placed in the bath at  $-2.0^{\circ}\text{C}$ , with the temperature being reduced by  $0.5^{\circ}\text{C}$  each half hour until the temperature reached  $-7.5^{\circ}\text{C}$ . At each setting the bath was allowed to equilibrate for 25 minutes, after which test tubes in which the water had frozen were removed and the data recorded.

**Table 1. Treatments, date of application, and recommended rate applied in 300 gallons of water to Lisbon lemons.**

Material	Date	Rate Applied
Unocal Plus (Unocal)	12-18-89	5 liters/20 gals.
Frostgard (Custom Chemicals)	12-19-89	2 percent
Kocide 101 (Griffin Ag Prod.)	12-20-89	5 lbs./acre

### Results and Discussion

The results provided in Table 2 indicate that the only statistical difference occurred between Unocal Plus and the untreated control trees on the first evaluation two days after application. Although the number of trees per plot were doubled and the leaf samples per tree were increased from 8 to 12, there still appears to be a fair amount of variability among both the treated and untreated trees, making it difficult to draw any firm conclusions.

**Table 2. Average Temperature (C) at which distilled water with leaf samples froze in bath.**

Treatment	Day 2	Day 8	Average
Unocal Plus	-5.8a*	-4.7a	-5.2
Control	-5.2b	-4.8a	-5.0
Frostgard	-5.7a	-4.4a	-5.1
Control	-5.5a	-4.5a	-5.0
Kocide 101	-5.0a	-4.0a	-4.5
Control	-4.8a	-4.6a	-4.7

\* Treatments followed by the same letter are not statistically different from one another at the 5 percent level using the Student-Newman-Kuels Test for comparison of multiple means.