# CONTROLLED ATMOSPHERES AS A QUARANTINE TREATMENT FOR VARIOUS ARTHROPOD PESTS

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We previously reported on research results using high carbon dioxide atmospheres for control of three arthropod pests of table grape, omnivorous leafroller (*Platynota stultana* Walsingham), western flower thrips (*Frankliniella occidentalis* Pergande) and Pacific spider mite (*Tetranychus pacificus* McGregor). A treatment with 45% carbon dioxide in air (11.5% oxygen) at 0°C (32°F) has been developed. Based on data analysis and assuming the Probit model, the treatment is projected to provide Probit 9 mortality of the most resistant lifestage, Pacific spider mite protonymphs, within 9 to 11 days. Grape response to 10 or 15 days of such treatment was insignificant. This treatment is currently under review.

We have begun to explore other CA treatment regimes which may also provide quarantine security for these table grape pests and which may prove more convenient for commercial use. These treatments include short-term shock treatments with high CO2 atmospheres followed by an 18 day "voyage" at 0°C in air or in lower $CO_2$ atmospheres. Our treatments have focused on Pacific spider mite as they were most tolerant to other CA atmospheres tested previously. Shock treatments of 65, 80 and 95% CO2 for 1, 2 or 3 days at 0°C were initially tested without the 18 day voyage. Mortality averaged from 20 to 40% (1 day), 30 to 80% (2 days) and 55 to 90% (3 days), depending on the lifestage and $CO_2$ concentration. In general, the higher the $CO_2$ concentration and the longer the shock treatment, the greater the mortality. The short-term shock treatment of 1 to 3 days was then followed by an 18 day exposure to 20% CO2 with 5% O2 at 0°C (CA voyage simulation). The 18 day exposure to 20% CO2 with 5% O2 without a shock treatment gave greater than 90% mortality and addition of a 1, 2 or 3 day shock treatment, regardless of the CO2 concentration, provided 100% mortality. Exposure to 0°C in air for 21 days without any type of CA treatment resulted in from 25 to 80% mortality indicating that exposure to cold temperatures for up to 3 weeks may provide significant mortality (see below).

In the next experiment, the length of the "voyage" was varied from 7 to 14 to 18 days in combination with a one-half day shock treatment with 65, 80 or 95% CO2. For the 18 day voyage with the one-half day shock treatment, 100% mortality was reached, regardless of the $CO_2$ concentration used during the shock treatment. With the 14 day voyage, mortalities were greater than 95%, however survivors occurred in all treatment combinations. Mortalities were much lower with the 7 day voyage (65 to 100%).

A third experiment was initiated to determine the effectiveness of a $CO_2$ shock treatment followed by an 18 day "voyage" in air at 0°C. A 1 day shock with 90% CO2 in combination with 18 days at 0°C provided 100% mortality, a 3 day shock at 65, 80 or 95% CO2 provided 100% mortality when followed by 18 days at 0°C.

Future work will continue in this area and grape fruit response to the different treatment regimes will be tested.