

Biology/Phenology

The Effectiveness of Combined Heat and Controlled Atmosphere for Potential Quarantine Treatments

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A unique hot forced air chamber was designed and built to facilitate the development of nonchemical quarantine treatments for apples, pears, and cherries infested with codling moth. The chamber allows for the control of atmospheric gases, temperature, dew point, and air speed. Previous research has demonstrated that high temperature treatments (110 to 120°F) can be effective in killing codling moth larvae in fruit. Both the temperature and the rate at which the temperature is increased have a dramatic effect on insect mortality. It is also known that high carbon dioxide, low oxygen atmospheres in combination with elevated temperatures have a greater effect on insect mortality than heat treatments alone. What is not known is how these treatments affect fruit quality. The CATTs, Controlled Atmosphere/Temperature Treatment System, allows for the manipulation of many parameters which will be used to test their effects on insect mortality and fruit quality.

Apples and pears were heated treated using various rates of heating and temperatures. Core temperatures were recorded and used to treat fifth instar codling moth in a computer operated insect respiration monitoring system which records CO₂ levels. Insect respiration increased in correlation to the heat treatment up to an ultimate peak. In those treatments resulting in mortality, respiration declined to zero following the peak. For treatments which were not effective in causing mortality, respiration reached a level above the initial start point in relation to the metabolic heat load. Respiratory response to heat treatments indicates the critical points at which the application of a controlled atmosphere would be most effective in causing insect mortality.

'Bing' cherries infested with 5th instar codling moth were treated at either 45 or 47°C with and without the application of a controlled atmosphere (1.0% O₂ and 15% CO₂). There was a dramatic effect on larval mortality in the combined treatments over that of the heat treatment alone. LT_{99s} of the heat alone vs. heat + CA treatments were 124 min vs. 64 min for the 45°C treatment and 72 min vs. 44 min for the 47°C treatment. The total time of treatment can be greatly reduced when a controlled atmosphere is part of the procedure. This research demonstrates the potential effectiveness of combined heat with controlled atmospheres as a quarantine treatment against codling moth larvae in sweet cherries.

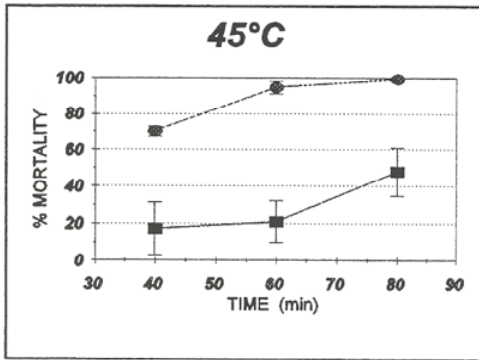


Figure 1. Mortality of fifth instar codling moth infesting sweet cherries to heat-■, and heat + CA-●, treatments at 45°C.

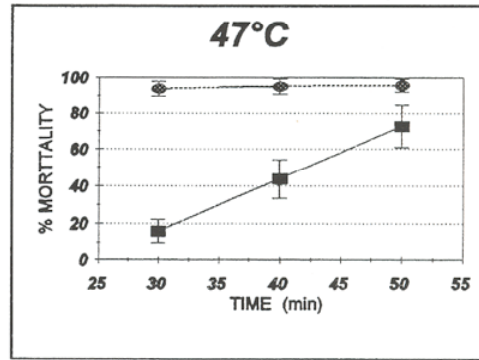


Figure 2. Mortality of fifth instar codling moth infesting sweet cherries to heat-■, and heat + CA-●, treatments at 47°C.