CAN SWEET CHERRY TAKE THE HEAT?

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The California and Washington sweet cherry industries are dependent on fumigation with methyl bromide for export of sweet cherries to Japan. The insect pest of concern is codling moth. Because of the insect pest and the commodity, which has a short storage life, there are limited alternatives for quarantine treatments. Cold treatment requires in excess of 3 months for control of codling moth. This is unacceptable for a perishable commodity like sweet cherry. Controlled atmospheres (CA) in cold storage is no better than cold storage alone and CA at 70 to 75°C requires one to three weeks at a minimum for codling moth control. Irradiation is a possible treatment if the Japanese will accept it and regulations can be adjusted to allow for live, sterile insects. Although heat treatments might not come to mind when you think of cherries, heat would provide a rapid treatment Also, the Japanese are comfortable with heat treatments and some forced hot air chambers are manufactured in Japan. Victoria Yokoyama at USDA in Fresno, California previously demonstrated the effectiveness of heat for control of codling moth. We have expanded on her work (see Neven's abstract) and developed several time and temperature combinations which provide for control of codling moth. Our goal was to determine whether sweet cherry could take the heat.

In 1993, we began testing the tolerance of sweet cherry to heat treatments. We tested both hot water and hot air treatments at temperatures ranging from 45 to 49°C (113 to 120°F) for times of 5 to 40 minutes. After heating, fruit were hydrocooled and evaluated after one day and after storage at 0°C (32°F) plus simulated shipping and marketing. Fruit were evaluated for firmness, % soluble solids, % titratable acidity, internal or external injury, stem condition and decay.

Cherry fruit have the advantage of heating very quickly. Fruit centers achieved treatment temperature within 10 minutes. The fruit responded to hot air treatments better than hot water treatments. Hpwever, hot air treatments resulted in more stem browning than hot water treatments and testing at different humidity levels indicated this was related to relative humidity during the test. Fruit quality was acceptable for one week of storage after treatment at 45°C (113°F) for 60 minutes and 47°C (117°C) for 20 minutes. Both of these treatments should result in quarantine security against codling moth.

In 1994, we obtained a prototype computer-controlled forced-hot air/controlled atmosphere chamber which was used for fruit testing. Fruit were obtained immediately after harvest, sorted and subjected to one of two treatments, 45°C (113°F) for 80 to 100 minutes and 47°C (117°C) for 45 to 55 minutes. Treatment times were longer than in 1993 because chamber air was ramped from ambient temperature to treatment temperature. This meant that fruit heated more slowly which increased insect tolerance and increased time to get fruit center to treatment temperature. In comparing the two different treatment temperatures, we found that the shorter treatments at higher temperatures generally resulted in better fruit condition after treatment. Fruit condition after treatment was also closely linked to condition before treatment. Firm fruit of good maturity and fresh stem condition withstood the treatment and remained in good condition for one week of storage after treatment (Table 1). Gibberellic acid (GA) treated fruit also appeared to withstand the treatment better than non-GA treated fruit, perhaps due to increased firmness.

We also began testing the effects of controlled atmospheres at elevated temperatures on codling moth mortality and fruit quality. Initial testing was at 15% CO2 and 1% O2 at 45°C (113°F) and 47°C (117°C). Sweet cherries respond to high CO2 favorably and high CO2 at high temperatures is fatal to codling moth. The time required for insect mortality was much less with CA than without (see Neven abstract). During fruit evaluations, we observed increased stem browning and internal browning in CA heated cherries. The increase in stem browning may have been caused by lower treatment relative humidities due to introduction of large volumes of dry CO2 and nitrogen. This situation has been remedied on the treatment chamber and we plan to test different combinations of atmospheres and temperatures on both codling moth and cherries next season.

In terms of our original question, "Can sweet cherry take the heat?", the verdict is still out. Heat treatment alone may prove to be marginal for cherry quality. There may be greater success in a combination heat and CA treatment. We intend to do more testing on both to allow us to better answer the question.

Table 2: Resulting quality of sweet cherries after forced hot air treatment, hydrocooling, storage one week at 0°C (32°F) and 3 days at 5°C (41°F).

Treatment	Firmness (lbs.)	% SS	% TA	Stems	Pitting	Internal
No Heat	381	22.2	1.02	1	1	0
45°C (113°F) 90 min	383	22.6	0.99	3	1	0
45°C (113°F) 100 min	405	22.9	1.01	3	1	1
47°C (117°F) 45 min	415	24.2	1.07	1	1	0
47°C (117°F) 55 min	414	23.2	1.01	2	1	1

stems, pitting, internal: 0 = none; 1 = slight; 2 = moderate, 3 = severe.
% SS = percent soluble solids
%TA = percent titratable acidity

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