METHODS WHICH MAY PROVE BENEFICIAL TO MAINTAINING SWEET CHERRY QUALITY AFTER QUARANTINE TREATMENTS

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In 1998, Washington shipped a total of 60,206 metric tons of mahogany and 3,622 tons of yellow 'Rainier' sweet cherries to market (Northwest Cherry Growers). The sweet cherry market is built on the quality reputation of one dark mahogany cultivar, 'Bing'. A second cultivar of importance is the red blushed yellow 'Rainier'. There are a number of excellent cultivars which ripen before, during, and after 'Bing'. Research programs are bringing new cultivars to the market. Washington State University has named and released the mahogany cultivars Chelan, Tieton, and Cashmere. The soluble solids of good sweet cherries exceed 16 Brix and reach more than 22 Brix. Sweet cherries from the Pacific Northwestern United States are known for a good balance between sugars and acids.

In 1998, the Pacific Northwest sweet cherry harvest began the second week of June. Harvest continued until the end of July from the further northern portions of the state and from higher elevations. Harvesting costs alone for sweet cherries are estimated to be $.15 lb. Production, packing, and transportation substantially raise the cost for this premium fruit. Substantial quantities of sweet cherries are exported each year. In 1998, 19,388 metric tons (32 percent) of mahogany sweet cherries were exported. The export destinations vary from year to year, but in 1998, the 5 largest export destinations were as follows; Taiwan (5291 mt tons), Canada (3636 tons), United Kingdom (3258 tons), Japan (2763 tons), and Hong Kong (1972 tons).

The basis of the United States Japanese sweet cherry export is the use of methyl bromide for quarantine treatment. The quarantine pest of concern to Japan is codling moth (*Cydia pomonella*). Domestic sweet cherry production in Japan varied from 11,500 (1996) to 16,800 (1997) metric tons between 1993-1997 (Japanese Ministry of Agriculture Forestry and Fisheries, MAFF). The use of methyl bromide for sweet cherry fumigation may be discontinued because its placement on the list of ozone depleting substances.

Cherries are not considered a natural host of codling moth in the Pacific Northwest, but the concern lingers that they might harbor an occasional larva. Dr. Hal R. Moffitt (USDA ARS, retired) collected information on 8,614,742 cartons of cherries which had been inspected by the USDA APHIS and/or state inspectors under APHIS direction and exported to selected markets between 1978-1996. Dr. Moffitt found that only 1 codling moth larvae was found in 8 million cartons of sweet cherries exported from the Pacific Northwest. Dr. Moffitt also collected information on 5,585,991 cartons of sweet cherries exported from California from 1987-1996. Only 7 codling moth larvae were found in the California cherries during this period of time.

Methyl bromide alternatives for sweet cherry quarantine "treatments" seem to be sorting

out as follows.

- Seek exemption for quarantine treatment using methyl bromide
- Recapture methyl bromide and either destroy or recycle in some manner
- Substitute another fumigant in place of methyl bromide
- Irradiation
- Thermal treatment (hydro-heating, vapor heating, microwave)
- A systems approach by which a series of hurdles and inspections meet quarantine concerns

Each treatment has proponents. Some of the treatments are closer to being realized in terms of the supporting research. The economics of putting into place competing quarantine treatments have not been examined. The amount of information on the effect of alternative quarantine treatments on fruit quality is minimal. All treatments should be considered detrimental to maintaining the quality of the treated fruit. The additional handling and time, alone, is detrimental to maintaining sweet cherry quality.

Thermal treatments have a history of use for quarantine purposes. A great deal of effort is going into different heating methods to meet codling moth quarantine treatment efficacy. Most horticulturists and postharvest physiologists would agree that heating sweet cherries is detrimental to quality and shelf life.

Assuming that heating sweet cherries becomes a viable option for sweet cherry quarantine treatment, the objective would be to ameliorate some of the harmful effects of heating. Hydro-heating would be the most rapid method of heat conduction into sweet cherry fruit except microwave. Some of the ameliorating methods include the following:

- Heat sweet cherries in heated air and/or vapor
- Alter the gas concentration in the heated air under the assumption that codling moth larvae will succumb in a heated low oxygen environment
- Ramp the heating to “condition” sweet cherries to withstand elevated temperatures for time sufficient to kill codling moth larvae
- Utilize only freshly harvested fruit with the assumption that the youthful fruit would be able to recover from thermal treatments
- Or assume that youthful fruit would be more tolerant of heat

The following are methods which may prove beneficial in maintaining sweet cherry quality after quarantine treatments:

- Package in a modified atmosphere
- Hydro-heat in osmotically adjusted GRAS solutions such as glycerol
- Add anti-oxidants such as ascorbic acid
- Utilize GRAS food preservatives such as citric acid and potassium sorbate

The Mortality of Codling Moth Larvae Hydro-Heated at 40 ^{0}C, 45 ^{0}C, and 50 ^{0}C Within Infested Sweet Cherry Cultivars

The cherries were infested with late 3rd, 4th , and early 5th instar codling moth larvae. The sweet cherries were hydro-heated 2 days after infestation, plunged into ice water for 15 minutes, and held one day at ambient room temperature before the larvae were examined for mortality. The treatments were replicated 3 times.

	Cultivar	Control	15 min	30 min	45 min	60 min
40 ^{0}C	Chelan	4.63	34.86	57.54	83.33	83.88
	Bing	3.40	38.75	53.64	75.70	96.93
	Chinook	14.98	30.95	58.56	73.08	92.36
45 ^{0}C	Chelan	11.20	94.85	99.63	**100.00**	**100.00**
	Bing	5.04	99.26	99.26	**100.00**	**100.00**
	Chinook	7.94	81.11	99.63	**100.00**	**100.00**
50 ^{0}C	Chelan	10.36	**100.00**	**100.00**	**100.00**	**100.00**
	Bing	7.31	**100.00**	**100.00**	**100.00**	**100.00**
	Chinook	7.48	**100.00**	**100.00**	**100.00**	**100.00**

The Mortality of Western Cherry Fruit Fly Maggots in Naturally Infested Sweet Cherry Cultivars Hydro-Heated to 40 ^{0}C and 45 ^{0}C

Highly infested sweet cherries were obtained from unsprayed trees. The infested cherries were hydro-heated and for one week the maggots were caught that exited the fruit. The western cherry fruit fly maggot mortality figures were adjusted to the controls. The treatments were replicated.

	Cultivar	Control	15 min	30 min	45 min	60 min
40 ^{0}C	Rainier	0.00	45.24	66.67	76.19	90.48
	Bing	0.00	84.95	90.32	96.77	94.63
45 ^{0}C	Rainier	0.00	89.47	**100.00**	**100.00**	**100.00**
	Bing	0.00	96.04	**100.00**	**100.00**	**100.00**