Irradiation as a alternative to methyl bromide for quarantine treatment of sweet cherries

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Fumigation of fruit products with methyl bromide (MeBr) to control insect pests has met with varying degrees of success due to injury to the host fruit. At the present time, regardless of the problems associated with fumigants, MeBr is the only fumigant accepted by most countries that import fruits from the United States. In the near future MeBr will be banned from use as a fumigant. To continue to export agriculture commodities, alternatives to MeBr must be determined. One such alternative to MeBr is irradiation. Levels of gamma irradiation necessary to sterilize can cause severe injury to fresh commodities, but low dose gamma irradiation (1000 gy's or less) can control insect populations with little or no quality loss in the fresh commodities. Most of the previous studies with irradiation, as a quarantine treatment, have compared different dose levels of irradiation to a non-treated control. Few, if any studies have directly compared irradiation to MeBr and subsequent fruit quality. This study was initiated to compare the fruit quality of irradiated and MeBr treated cherries from similar growing locations.

Results

Both of the quarantine treatments used (MeBr and irradiation) reduced the firmness of Sing' cherries (Table 1). Sing! cherries irradiated at 300 gy's had less firmness (24%) than control or MeBr treated fruit. Cherries irradiated at 600 gy's had a firmness similar to MeBr treated cherries. Both MeBr and irradiated cherries had acceptable firmness regardless of irradiation dose. Irradiated 'Rainier' were less firm than either the control cherries or the cherries treated with MeBr. As irradiation dose was increased 'Rainier' cherries lost firmness, but not to the point where firmness would be unacceptable to the consumer. In this study firmness loss did occur and could be attributed to quarantine treatment. This loss of firmness was evident at all storage periods, or at 0, 7 and 14 days.

Soluble solids (SS). of both cultivars of cherries, was not influenced by quarantine treatment. Titratable acidity (TA) was reduced by irradiation regardless of dose in Rainier' cherries, but no change in TA was evident for irradiated Bing cherries. MeBr treated Sing cherries displayed TA higher than either the control or irradiated cherries. The ratio between SS and TA was identical in 'Bing, cherries regardless of treatment or control, but there was a difference in this ratio when 'Rainier' cherries were considered. The SS/TA ratio of irradiated Rainier' was higher

than the MeBr treated cherries and the cherries irradiated at 600 gy's was higher than either the control fruit or the cherries irradiated at 300 gy's. This difference in the SS/TA ratio might indicate possible flavor differences between irradiated Rainier' cherries and MeBr treated cherries.

Visual evaluations of both fruit and stem determined no difference between quarantine treatments for either Sing! or Rainier' cherries (Table 1). MeBr treated Rainier' cherry fruit and stems were scored intermediate between irradiated and the control and no statistical difference between MeBr treated and control fruit or MeBr treated and irradiated Rainier' were noted. No difference between treated and control 'Bing' cherries was evident when pitting and bruising were considered, but differences between treatments did exist when Rainier' cherries were considered. More bruising was present in irradiated 'Rainier' cherries than either the control or MeBr treated fruit. The amount of bruising present in treated or non-treated cherries was not unacceptable. No consist difference in pitting was present between quarantine treatments and control.

Color of cherry fruit was altered with quarantine treatment (Table 2). MeBr treated Sing' cherries were darker in color (lower Hunter L values) than either the control or irradiated cherries. Irradiated Sing' cherries were fighter in color than MeBr treated fruit. Control and irradiated 'Bing' cherries have similar hue values and were more red than MeBr treated cherries which had higher hue values (less red). Distinct differences between treatments in Hunter L color for Rainier' was not apparent, but there were differences between treatments for hue values. Both the control and irradiated cherries had higher hue values than MeBr treated fruit and were more yellow with less red than MeBr treated cherries.

No difference in stem Hunter L values were present between treatments for Bing' cherries. There was a difference in stem Hunter L values for Rainier' cherries. Stems of MeBr treated 'Rainier' cherries had higher Hunter L value s than either control or irradiated cherries, which indicated a lighter colored stem for this fruit. In both Bing' and Rainier' cherries hue values for irradiated stems were similar to control stems. MeBr treated stems had higher hue values than either control or irradiated stems and they would be a lighter green in color than other stems.

Conclusions:

Either irradiation or methyl bromide can be used as a quarantine treatment for Sing' and 'Rainier' sweet cherries with acceptable results and similar fruit quality. Use of irradiation results in some firmness loss when compared to MeBr, but irradiation of cherries does not result in a loss of fruit and stem color, where the use of MeBr results in color loss for both fruit and stern, for both 'Bing' and 'Rainier' cherries. Differences in stem condition and bruising were more evident for irradiated Rainier' cherries than MeBr treated fruit, but these differences were small.

Table 1. Quality attributes of ‘Bing’ and ‘Rainier’ cherries after quarantine treatment with methyl bromide, or irradiation.

Quarantine Treatment	Firmness (N)	Soluble Solids (%)	Titratable Acidity (%malic)	SS/TA ratio	Condition[z] Fruit	Stem	Bruising[y]	Pitting[y]
				'Bing'				
Control	8.2ax 1.2a	22.8a	0.85b	27.Oa	1.3a	1.3a	1.2a	
MeBr	7.9ab 1.2a	22.7a	0.91a	25.Oa	1.3a	1.3a	1.3a	
300 gy's	7.2c 1.2a	22.2a	0.85b	26. la	1.3a	1.3a	1.2a	
600 gy's	7.5bc 1.2a	22.5a	0.85b	26.4a	1.3a	1.3a	1.3a	
				'Rainier'				
Control	6.2ab 1. 1b	23.4a	0.63ab	37.1b	1.2ab	1.1c	1.3b	
MeBr	6.3a 1.2a	23.8a	0.67a	35.5c	1.3ab	1.3bc	1.3b	
300 gy's	6.Ob 1.2a	23.Oa	0.61b	37.7b	1.4a	1.5a	1.5a	
600 gy's	5.7c 1. Ib	23.3a	0.59b	39.5b	1.4a	1.4ab	1.5a	

[z]Condition of fruit and stem graded on a scale of 1 to 3 (1 =good, 2=fair, 3=poor).
[y]Bruising and pitting graded on a scale of I to 3 (I=none, 2=slight, 3=severe).
[x]Means in a collumn, within cultivars, not followed by a common letter are significantly different (LSD, P>O. 05).

Table 2. Fruit and stem color of ‘Bing’ and ‘Rainier’ cherries after quarantine treatment with methyl bromide or irradiation.

	Fruit		Stem	
	Hunter L	hue	Hunter L	hue
Quarantine Treatment			'Bing'	
Control	34.9a[z]	10.9bc	27.9a	89.4b
MeBr	28.7c	12.9a	28.2a	91.3a
300 gy's	32.2b	9.4c	28.3a	90.3b
600 gy's	34.Oa	11.0b	29.0a	90.0b
			'Rainier'	
Control	61.1ab	64.9a	34.3b	97. lb
MeBr	58.6b	56.8b	38.1a	103.5a
300 gy’s	58. Ib	62.Oa	35.1b	94.7b
600 gy's	62.3a	64.6a	34.4b	95.4b

[z]Means in a column, within cultivars, not followed by a common letter are significantly different (LSD, P>0.05).