EFFECTS OF LOW DOSE IRRADIATION ON QUALITY OF 'RAINIER' CHERRIES

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'Rainier' cherries, with and without gibberellic acid treatment were subjected to radiation in 1993 at dose levels of 0.0, 0.1, 0.2, 0.3, 0.4, 0.5, and 1.0 KGy and held for 14 and 21 days at 1°C before removal from storage and quality determined. No variation in fruit or stem color, soluble solids, titratable acidity or sensory difference was noted at any of the radiation dose levels. There was 13% loss in firmness due to radiation treatment between 0.4 and 1.0 KGy. Cherries that were treated with gibberellic acid were superior candidates for radiation treatment. 'Rainier' cherries can be irradiated as soon as quality parameters have reached acceptable levels for commercial harvest.

'Rainier' cherries were obtained from plots of 3 trees each of GA_3 treated and nontreated fruit located at the Washington State University, IAREC, Prosser, WA. Fruit from individual trees were used as replicates. Trees were sprayed with GA_3 at 20 ppm in early May. Cherries were harvested at minimum commercial maturity and again 10 days later. At harvest, cherries were field-packed into 3-kg boxes with liners. Cherries were held overnight at 1°C and transported to the radiator the following day. All radiation treatments were conducted at Battelle-Pacific Northwest Laboratory, Richland, WA using a gamma beam 650 source containing cobalt-60. Distance from the source was adjusted to provide a dose rate of 8.32 Gy/min and exposure time to give total doses of 0, 0.1, 0.2, 0.3, 0.4, 0.5 and 1.0 KGy. Exposure rate was measured using a commercially available small volume ionization chamber made from air-equivalent plastic. After treatment cherries were transported to Wenatchee, WA and placed in storage at 1°. At 14 and 21 days after harvest cherries were removed from storage and examined for quality. At each examination time 1 kg of fruit was removed from each treatment (harvest/growth regulator/radiation). One-half (500 g) of the fruit were examined immediately and the other 500 g examined after 24 h at ambient temp.

Quality evaluations consisted of fruit weight loss, objective and subjective color, firmness, soluble solids content, titratable acidity and sensory evaluations. Weight loss of fruit was determined by weighing before and after 24 h at ambient temperature. Objective color of fruit and stems was determined with The Color Machine (Pacific Scientific, Silver Springs, Md) using the Hunter "L", "a", and " b" system and calculated hue values (Hunter and Harold 1987). Subjective color was determined using two laboratory personnel familiar with cherry color grades. Fruit and stems were rated individually on a scale of 1 to 3 (1=best, 3=poorest) and the mean values reported. Firmness was determined using the Universal TA-XT2 Texture analyses equipped with a 3-mm probe set at 10 mm/sec and a penetration distance, after contact, of 7 mm. Soluble solids content of the fruit was determined by an Abbe-type refractometer with a sucrose scale calibrated at 20°. Acids were titrated to pH 8.2 with 0.1 N NaOH and expressed as the percentage of malic acid. Sensory evaluation using only the 0 and 1.0 KGy-treatment was conducted by individuals familiar with cherry flavor and color. Analysis of variance was determined by (SAS, 1985) with GA_3 application as the

main plot, harvest time as the sub-plot and irradiation levels, storage and ripening as sub-sub plots. Based on significant F-test, means were separated using the Waller-Duncan test.

Eakin *et al.* (1985) reported that on 'Bing' cherries control of codling moth can be achieved with a radiation dose of only 0.25 KGy, and cherry fruit fly can be controlled with a dose of only 0.15 KGy. In this study quality losses were not evident on 'Rainier' cherries with radiation doses up to 0.3 KGy regardless of harvest date. When radiation dose levels increased to 1.0 KGy the only quality attribute affected was firmness and then a 13% decrease was noted in 'Rainier' cherries. Considering radiation levels necessary for quarantine control (<0.5 KGy) and the lack of quality loss, particularly color, in 'Rainier' cherries with radiation dose levels up to 1.0 KGy, there is little doubt that 'Rainier' cherries are good candidates for treatment with radiation. Jessup (1990) also found that sweet cherries could be treated with radiation doses sufficient for disinfestation with little loss in quality. Quality loss in radiated sweet cherries is minimal particularly when one considers that more conventional means of fumigation (MeBr) can result in considerable quality loss (Drake *et al.*, 1991). Irradiated fruit of superior quality can be placed on the market when cherries are treated with GA before radiation. 'Rainier' cherries should be irradiated as soon as quality parameters reach acceptable levels (color, sugars, acids). A delay in maturity will result in irradiated fruit of reduced quality.

Drake, S.R., Moffitt, H.R. and Kupferman, E.M. 1991. Quality characteristics of 'Bing' and 'Rainier' sweet cherries treated with gibberellic acid, following fumigation with methyl bromide. J. Food Quality 14:119-125.

Eakin, D.E., Hungate, F.P., Tingey, G.L., Olsen, K.L., Fountain, J.B., Burditt, A.K., Moffitt, H.R., Johnson, D.A. and Lunden, J.D. 1985. Cherry irradiation studies: 1984 Annual report. Battelle-Pacific Northwest Laboratories, Richland, WA, 99352.

Jessup, A.J. 1990. Gamma irradiation as a quarantine treatment for sweet cherries against Queensland fruit fly. HortScience 25:117-121.

Table 1. Color of 'Rainier' cherries both fruit and stem as influenced by low dose radiation, gibberellic acid application, harvest date and storage time.

	Hunter Color							
	Fruit				Stem			
Radiation (KGy)	L	a	b	hue	L	a	b	hue
0.0	61.8 NS[z]	14.0 NS	17.9 NS	53.0 NS	43.1 NS	-1.4	10.4 NS	97.9 NS
0.1	62.2	13.6	17.8	53.2	43.0	-1.1	10.3	95.2
0.2	63.6	12.5	18.2	56.2	43.5	-1.7	10.6	99.3
0.3	62.2	13.0	17.8	54.2	44.0	-1.7	10.9	98.6
0.4	63.3	12.9	17.6	54.4	43.4	-1.6	10.5	98.3
0.5	63.3	12.8	17.4	54.2	43.4	-1.3	10.5	96.8
1.0	64.2	12.3	17.9	56.1	42.4	-1.1	9.7	96.1
Gibberellic Acid								
Yes	66.8 a[y]	9.0 b	19.4 a	65.1 a	42.4 b	-1.4 NS	9.5 b	97.8 NS
No	59.1 b	17.0 a	16.2 b	43.9 b	44.1 a	-1.5	11.3 a	97.1
Harvest								
I	62.8 NS	14.4 a	17.7 NS	51.6 b	41.6 b	-0.7 a	11.3 a	92.5 b
II	63.0	11.7 b	17.9	57.4 a	45.0 a	-2.2 b	9.5 b	102.4 a
Storage (days)								
14	62.1 b	12.2 b	16.1 b	53.5 NS	44.9 a	-1.6 NS	8.9 b	99.0 a
21	63.7 a	13.9 a	19.5 a	55.5	41.6 b	-1.3	11.9 a	95.9 b

[z]NS = No significant difference.
[y]Means within pairs not followed by a common letter are significantly different ($P \geq 0.05$).

Table 2. Quality attributes of 'Rainier' cherries as influenced by radiation, gibberellic acid, harvest date and storage time.

Radiation (KGy)	Firmness (N)	Soluble solids content (%)	Titratable acidity @ (% malic)	Weight (g)	Visual assessment	
					Fruit	Stems
0.0	5.7 a[z]	19.1 NS[y]	0.45 NS	11.2 NS	1.1 NS	1.3 NS
0.1	5.6 ab	19.3	0.46	11.3	1.4	1.3
0.2	5.5 abc	19.0	0.46	11.2	1.2	1.3
0.3	5.5 abc	19.3	0.46	11.3	1.2	1.3
0.4	5.4 bc	19.5	0.46	11.3	1.1	1.3
0.5	5.3 c	19.4	0.46	11.2	1.1	1.3
1.0	4.8 d	19.3	0.46	11.1	1.1	1.3
Gibberellic acid						
Yes	5.8 a	19.6 a	0.45 NS	12.2 a	1.2 NS	1.3 NS
No	5.0 b	18.9 b	0.47	10.2 b	1.1	1.3
Harvest						
I	5.8 a	19.1 NS	0.48 a	10.0 b	1.1 NS	1.1 b
II	4.6 b	18.9	0.44 b	12.8 a	1.2	1.4 a
Storage (days)						
14	5.1 b	19.0 NS	0.47 a	11.5 NS	1.1 NS	1.1 b
21	5.3 a	18.9	0.45 b	11.3	1.2	1.5 a

[z]NS = No significant difference.
[y]Means within pairs not followed by a common letter are significantly different ($P \geq 0.05$).