Injuries cause deterioration of sweet cherries

F. Gordon Mitchell ☐ Gene Mayer ☐ Adel A. Kader

Vibration and impact injuries hasten deterioration of harvested sweet cherries and increase fruit rot.

It has been suggested that surface and flesh browning of sweet cherries does not affect market performance and that such fruit may be rejected unnecessarily during inspection. In evaluating the problem, it is equally important to determine the cause and nature of the browning problem so that incidence or severity of the symptoms might be reduced where market performance is affected.

Preliminary laboratory tests were conducted with the Bing variety during the 1978 season, and expanded to include Early Burlat, Larian, and Bing cherries in 1979. During both seasons, freshly harvested fruits were injured by controlled impacts and vibration before evaluation. For comparison, in the 1979 season, an additional, small, commercially selected sample of Early Burlat fruit with the browning symptoms was furnished by the California Department of Food and Agriculture.

In the laboratory study, uninjured fruit was carefully harvested and subjected to the injury treatments within 2 hours of harvest. Treatments included dropping individual cherries 18 and 36 inches onto the bottom of a metal picking bucket and vibration of loose cherries for 10 and 20 minutes on a simulated transit vibrator adjusted to an acceleration of approximately 1.1 g. This latter treatment duplicates injuries caused by abrasions during handling and packing and by vibration motion during transport.

Following the injury treatments the fruits were stored for 4 days at 41° F (5° C), plus time at 68° F (20° C) as noted later, to simulate normal handling, transit, and marketing conditions. Commercially obtained samples were held under similar conditions for 4 days from the date of harvest, although temperature during the first 24 hours was not known. At harvest and after storage, all samples were evaluated for flesh firmness, soluble solids content, and total titratable acid. On removal from storage, samples were subdivided for evaluation of physiological and physical deterioration.

Samples for physiological evaluations, including the commercially obtained Early Burlat cherries, were placed at 68° F (20° C) in 1-quart respiration chambers under a constant humidified air flow. Rate of respiratory activity (as carbon dioxide production) and level of ethylene production were monitored daily for 2 to 4 days until deterioration (primarily fungal infections) was visible.

Samples for physical evaluations were placed for weight loss monitoring in small open-mesh baskets through which air could freely pass, but which were shielded from direct air flow. Air at 68° F (20° C) and approximately 70 percent relative humidity was in contact with the fruit during the 4-day holding period. At the start and end of this test, fruit weights were taken, and individual fruits were subjectively scored for visible stem browning and fruit deterioration.

Although microbial inoculations were not made, all samples were evaluated for rots at the end of the respiration measurements. Fruit for these evaluations was held at 68° F (20° C) and high relative humidity (greater than 95 percent) for 2 to 4 days before scoring.

Results

A general pattern of increased physiological activity, and thus accelerated rate of deterioration, was associated with the injuries, both those applied in the laboratory and those encountered commercially. Symptoms on commercial samples appeared closest to those on laboratory samples that had been vibrated for 20 minutes at 1.1 g acceleration (see photo). The table summarizes the results.

Respiratory activity

In all tests a trend toward higher levels of respiratory activity was associated with increasing severity of the injury treatment. This pattern was quite pronounced in most tests (a 2- to 3-fold difference between the control and fruit vibrated 20 minutes) but was only slight in the 1979 Bing test.

Ethylene production

Ethylene production varied considerably between and within tests. However, fruit receiving the more serious injury treatments consistently produced slightly higher levels of ethylene.

Weight loss

The relationship between injury and weight loss was not consistent in these tests. Injured Early Burlat and Bing cherries lost more weight than noninjured fruits in 1978, but Larian and Bing cherries in 1979 showed no clear pattern. Although data are incomplete, fruits picked at more advanced maturity may show greater correlation between injury and weight loss.

Injury

In all tests, samples receiving the injury treatments had higher injury scores and more serious discoloration than noninjured controls. This general pattern was also observed for effect of treatment on stem drying, but no clear trend was evident for Larian or in the 1978 Bing test.

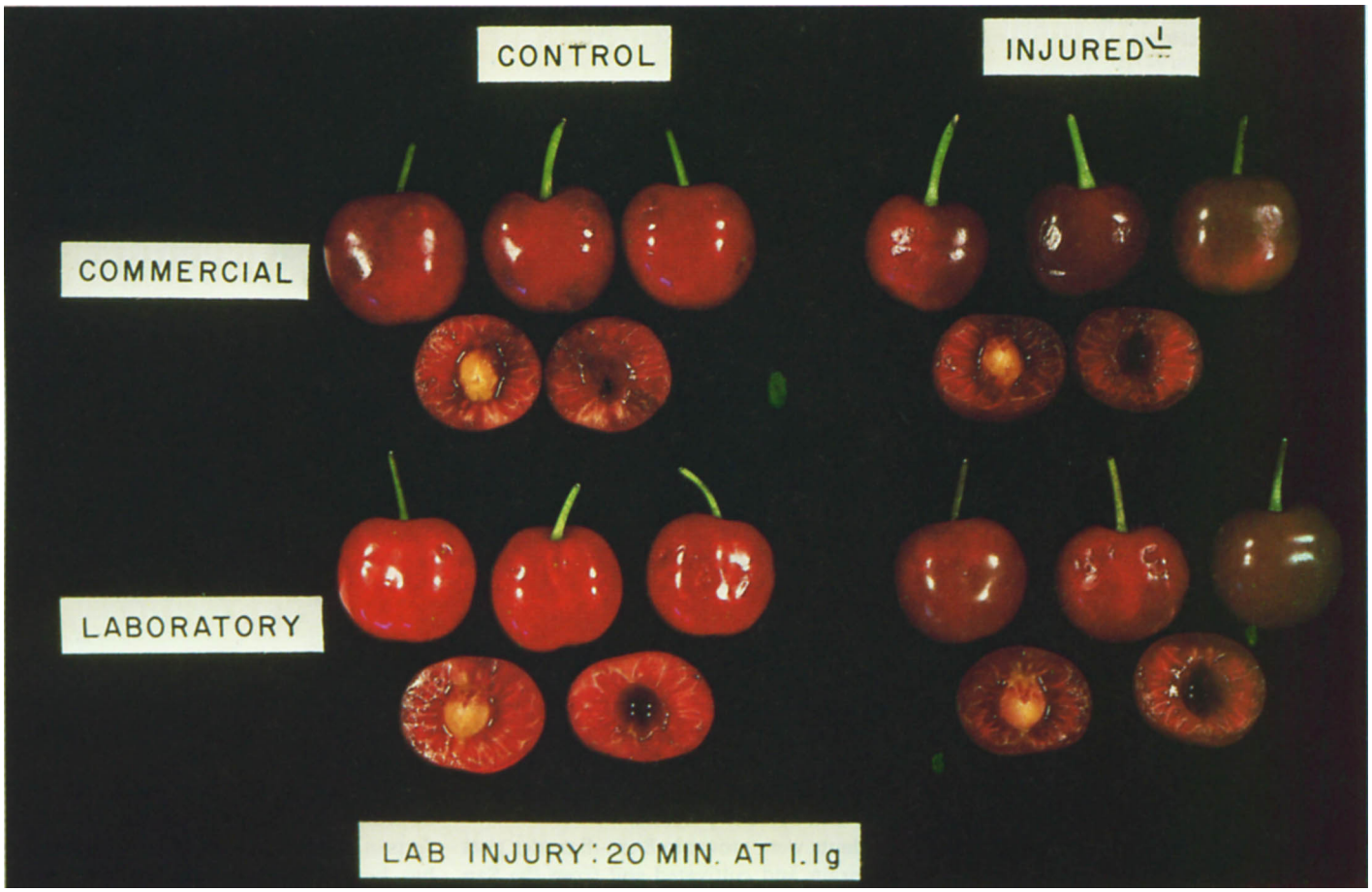
Fruit rot

There was a general and often pronounced trend toward higher incidence of rot in injured fruits, with the highest incidence in fruit injured by vibration. Much of the fruit rot was brown rot (*Monilinia* sp.), and some was grey mold (*Botrytis cinerea*).

Discussion

Physical injuries, such as those applied in these laboratory tests, measurably accelerate deterioration of sweet cherry fruits. Limited comparisons with commercially injured fruits suggest the symptoms of vibration injury most closely resemble those of concern within the cherry industry. Both impact and vibration injuries can cause substantial overall deterioration of appearance, an increase in physiological activity, and greater incidence of rot.

Where these injuries might occur commercially is not clear from these tests.



Laboratory-treated and commercially injured Early Burlat cherries with their respective noninjured controls.

Wind damage has been suggested as the source. Once during the 1979 cherry harvest season, ripe cherries were observed on the tree during and after a strong wind. Even after these fruit were harvested and held, they showed little injury and no severe injuries such as those obtained commercially, although the wind was strong enough to cause some fruit drop.

It is possible to speculate, but a careful study would be needed to pinpoint the major sources of this severe cherry injury. Areas of investigation should include picking, filling of buckets, transfer to boxes, loading, transport to the packing facility, all parts of the packing operation, box filling, and subsequent handling operations. Until specific sources of damage (which may vary from one operation to another) are identified, we recommend that more careful handling be practiced throughout the harvesting and postharvest handling system.

F. Gordon Mitchell is Extension Pomologist, Marketing, Gene Mayer is Staff Research Associate IV, and Adel A. Kader is Associate Professor of Pomology, University of California, Davis.

Relation of Injury Treatment to Tissue Discoloration and Deterioration Symptoms for Sweet Cherries

Test and variety*	Injury Treatment	Tissue discoloration† Score‡	Tissue discoloration† Serious (%)	Deterioration symptoms Resp. peak§ (mg Co2/kg/hr)	Deterioration symptoms Ethylene peak** (Ul/kg/hr)	Deterioration symptoms Weight loss (%)	Deterioration symptoms Dry stem (%)	Deterioration symptoms Rot†† (%)
Early Burlat	Control	1.4	13	64	1.67	8	6	14
F-177g	18" drop	2.2	31	69	2.55	9	2	55
S-12.1%	36" drop	2.6	52	75	2.18	9	5	50
A-0.59%	10 min vib.	4.0	99	113	1.24	10	15	84
	20 min vib.	4.5	100	193	1.72	13	27	99
Early Burlat	Control			92	0.84			
(commercial)	Discolored			110	1.52			
Larian	Control	0.7	1	36	0.14	9	25	1
F-335g	18" drop	0.9	6	48	0.36	8	23	4
S-13.5%	36" drop	1.5	14	66	0.10	9	16	3
A-0.84%	10 min vib.	1.7	24	67	0.35	9	33	8
	20 min vib.	3.0	70	72	0.69	9	27	25
Bing - 1978	Control	0.3	1	44		4	34	8
	18" drop	0.4	0	49		3	32	6
	36" drop	1.5	8	53		4	32	17
	10 min vib.	1.9	35	56		5	29	21
	20 min vib.	3.7	82	89		6	28	55
Bing - 1979	Control	0.3	0	45	0.50	7	27	7
F-282g	18" drop	0.8	0	46	0.57	7	34	10
S-16.7%	36" drop	1.4	8	50	0.82	7	37	13
A-1.24%	10 min. vib.	1.6	7	44	0.49	7	61	4
	20 min vib.	2.2	22	48	0.71	7	69	14

*Harvest measurements shown: F = flesh firmness, as measured with 3/16" (5 mm) tip on peeled surface (grams force). S = total soluble solids (percent). A = total titratable acid (percent).

†Fruit held 4 days at 41° F (5° C) and about 90% relative humidity (RH), plus 4 days at 68° F (20° C) and about 70% RH before evaluation.

‡Discoloration scores were: 0 = none, 1 = very slight, 2 = slight, 3 = moderate (interfere with marketing), 4 = severe, 5 extreme.

§Respiration peak: mg CO2/kg/hr = milligrams of carbon dioxide produced by the cherries per kilogram weight of fruit per hour.

**Ethylene peak: Ul/kg/hr = microliters of ethylene produced by the cherries per kilogram weight of fruit per hour.

††Fruit rot evaluations were made after 4 days at 41° F (20° C) and about 90% RH, plus 2 days (Early Burlat) or 4 days (Larian and Bing) at 68° F (20° C) and greater than 95% RH.