

Disorders in Sweet Cherry and Strawberry Shipments to the New York Market, 1972-1984

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Sweet cherries (*Prunus avium* L.) and strawberries (*Fragaria* × *ananassa* Duch.) rank behind only table grapes among small fruits consumed fresh in the United States. Average yearly deliveries of sweet cherries to New York City terminal markets in recent years have remained relatively constant at about 5,000 t. Strawberry deliveries averaged almost 16,000 t annually in the 1980s, a substantial increase from the 11,000 t delivered annually in the 1970s (16). The bulk of sweet cherry and strawberry deliveries to the New York market comes from the Far West and the South. Washington with 60% and California with 30% of the volume are the main suppliers of sweet cherries. California supplies more than 80% of the strawberries, with Florida remaining a distant second at 15% (16,17).

Fresh cherries and strawberries are highly perishable, and USDA inspections of their condition in certain shipments at arrival on terminal markets are often requested by receivers or shippers, especially when a shipment's quality is suspect. USDA inspectors on the New York market routinely examine six randomly selected boxes of the commodity in these shipments to reach a definitive stance on condition and examine more as needed. The inspections are reported on official USDA certificates that can be used as prima facie evidence in the litigation of loss claims. Access to these certificates over a number of years has enabled us to report now on the incidence and extent of disorders that lower quality and cause physical losses of sweet cherry and strawberry fruits.

This report is another in a series (1,2,5-10) dealing with the condition of fresh fruit and vegetable shipments on arrival at the New York City terminal markets. The information presented here on the arrival condition of sweet cherries and strawberries should provide the industry with useful guidelines for planning research to reduce the excessive losses that are presently encountered during marketing of these commodities (3,4).

Sweet cherries. USDA personnel inspected 2,455 shipments of sweet cherries at New York terminal markets during 1972-1984 (Table 1). These shipments approximated 25% of all cherry deliveries during this period (14,15). About 0.6% of the fruit in these shipments was actually inspected. Twenty-three disorders of cherries were either named or described by inspectors trained to identify disorders, including diseases. Commonly, two or more disorders were reported per shipment.

Blue mold rot (*Penicillium expansum*) of sweet cherries was the most damaging of the seven parasitic diseases, being reported in 35% of the shipments and distributed throughout all incidence classes from 1-5% to more than 50% (Table 2). Unidentified decays were reported in 35% of the cherry inspections, nearly all in the 1-5% incidence class. Gray mold rot (*Botrytis cinerea*) and Rhizopus rot (*Rhizopus* spp.) were noted in about 15 and 4%, respectively, of the shipments and were distributed in all incidence classes. Brown rot (*Monilinia*

spp.), Cladosporium rot (*C. herbarum*), and Alternaria rot (*A. alternata*) were the other diseases identified, but only in relatively few shipments.

A disorder termed "pitting" was reported most frequently in sweet cherry shipments (Table 2). Pitting was noted in 80% of the inspections, was distributed throughout all incidence classes, and damaged more than 10% of the fruit in almost a quarter of the cherry shipments. The disorder is manifested principally by sharply sunken, irregularly shaped pitted areas on the fruit. Some western researchers have attributed the condition to the result of rough handling and bruising of the fruit (11,15). The prospects of the disorder being physiological in nature cannot be ruled out, however.

A brown discoloration of sweet cherries that usually involves the internal tissues is an apparent physiological disorder that has puzzled federal inspectors and market researchers. The disorder is usually firm and affects all or a part of the fruit. It was reported in 37% of the cherry inspections, and about one-seventh, or 123, of these shipments had more than 10% of the fruits affected. An internal browning has been associated with impact bruising during harvesting of cherries (15). Another physiological disorder of importance was soft fruit (42%). Fruit cracking, related to absorption of excess moisture in the field or during transit, was reported in relatively few shipments (5%) (Table 2).

Pitting, soft fruit, and brown discoloration were reported more often than blue mold rot, the leading parasitic disease. For the former disorders, however, along with other nonparasitic ones, the U.S. No. 1 grade tolerance is 10-12% (solely or collectively), much higher than the 2% tolerance for decay.

Table 1. Load volumes of sweet cherries and strawberries inspected by the USDA on the New York market, 1972-1984

Year	Sweet cherries		Strawberries	
	Shipments (no.)	Packs ^a (no.)	Shipments (no.)	Packs ^b (no.)
1972	168	211,311	1	192
1973	230	291,013	153	146,670
1974	164	226,646	82	89,638
1975	290	401,637	153	172,570
1976	231	349,415	156	178,509
1977	73	76,681	96	128,000
1978	79	95,125	102	126,364
1979	193	221,044	44	27,593
1980	132	168,086	84	87,131
1981	62	37,175	76	71,678
1982	113	99,549	162	174,719
1983	307	298,338	256	235,705
1984	413	417,453	412	491,073
Total	2,455	2,893,473	1,777	1,929,842

^a Cartons or lugs with 8.17 kg (18 lb) or 9.08 kg (20 lb) of fruit.

^b Flats with 12 1-pt (473 cm³) baskets of fruit.

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Table 2. Frequency of disorders in USDA inspections of 2,455 sweet cherry shipments on the New York market, 1972–1984

Disorder	Shipments affected (%)	Number of shipments affected according to incidence class (% fruit)						
		0	1–5	6–10	11–20	21–33	34–50	>50
Pitting	79.8	497	739	622	474	98	23	2
Soft fruit	42.2	1,420	531	275	167	49	8	5
Brown discoloration	37.3	1,540	542	250	101	20	2	0
Blue mold rot	35.1	1,594	553	231	52	15	8	2
Bruise damage	35.0	1,596	367	321	152	17	2	0
Unidentified decays	31.6	1,680	763	10	1	1	0	0
Gray mold rot	14.5	2,099	251	58	33	4	5	5
Scarring	10.4	2,200	236	19	0	0	0	0
Cracking	5.2	2,327	104	20	4	0	0	0
Rhizopus rot	4.2	2,351	74	17	5	2	3	3
Freeze damage	1.7	2,413	4	9	7	8	5	9
Shriveling	1.5	2,417	23	9	3	1	1	1
Misshapen fruit	1.3	2,422	32	1	0	0	0	0
Cuts/punctures	1.3	2,423	23	9	0	0	0	0
Sunken discoloration	0.8	2,436	11	6	2	0	0	0
Miscellaneous rots ^a	0.7	2,437	17	1	0	0	0	0
Others ^b	1.2	2,425	26	2	0	1	1	0

^aBrown rot, Cladosporium rot, and Alternaria rot.

^bPulled stems, split pits, doubles, growth cracks, and insect injury.

Table 3. Frequency of leading diseases and physiological disorders of sweet cherries reported in USDA inspections of shipments to the New York market from major sources of supply, 1972–1984

Source Disease	Shipments affected (%)	Number of shipments affected according to incidence class (% fruit)						
		0	1–5	6–10	11–20	21–33	34–50	>50
Washington (981 ^a)								
Pitting	83.2	165	274	275	198	52	15	2
Blue mold rot	33.7	650	195	111	20	3	2	0
Unidentified decays	31.6	671	304	5	1	0	0	0
Brown discoloration	30.6	681	200	69	27	4	0	0
Gray mold rot	11.9	864	78	23	16	0	0	0
Rhizopus rot	3.5	947	24	5	4	0	0	1
California (891 ^a)								
Pitting	71.3	256	279	194	147	14	1	0
Brown discoloration	39.4	540	178	113	46	13	1	0
Blue mold rot	38.2	551	221	79	26	8	5	1
Unidentified decays	29.2	631	254	5	0	1	0	0
Gray mold rot	14.5	762	93	21	6	4	3	2
Rhizopus rot	4.2	854	23	8	1	2	2	1
Oregon (388 ^a)								
Pitting	91.2	34	108	113	98	29	6	0
Unidentified decays	39.7	234	154	0	0	0	0	0
Brown discoloration	34.3	255	85	33	14	1	0	0
Blue mold rot	29.1	275	81	28	2	1	1	0
Gray mold rot	14.4	332	44	6	5	0	1	0
Rhizopus rot	4.4	371	16	0	0	0	1	0
Chile (49 ^a)								
Pitting	63.3	18	20	6	5	0	0	0
Gray mold rot	51.0	24	13	5	3	0	1	3
Blue mold rot	28.6	35	9	1	3	1	0	0
Brown discoloration	22.4	38	9	1	1	0	0	0
Rhizopus rot	20.4	39	7	3	0	0	0	0
Unidentified decays	14.3	42	7	0	0	0	0	0

^aNumber of shipments.

The most prevalent injury reported was bruise damage (35%). Other types of injury noted, in declining order of occurrence, were scarring, freeze damage, cuts/punctures, and insect injury (Table 2).

Shriveling, misshapen fruit, and sunken discoloration were of minor importance, and occurrence of pulled stems, split pits, doubles, and growth cracks was negligible (Table 2).

Frequencies of the leading diseases in sweet cherry shipments from the main sources of supply are shown in Table 3. Blue

mold rot, gray mold rot, Rhizopus rot, and unidentified decays, along with the physiological disorders of pitting and brown discoloration, were most common in cherry fruits originating from Washington, California, Oregon, and Chile. Pitting was the leading disorder in shipments from all four growing regions. Occurrences of blue mold rot ranged from 28 to 38% and of gray mold rot, from 12 to 51%. Rhizopus rot was reported in 4% of the domestic shipments and in 20% of the Chilean shipments. Gray mold rot was also substantially higher in foreign than in

Table 4. Parasitic diseases associated with other disorders in USDA inspections of 2,455 sweet cherry shipments on the New York market, 1972–1984

Disease	Shipments affected (no.)	Prevalence of disorders								
		Pitting (%)	Brown discoloration (%)	Soft fruit (%)	Bruise damage (%)	Cracking (%)	Blue mold rot (%)	Unidentified decays (%)	Gray mold rot (%)	Rhizopus rot (%)
Blue mold rot	861	78.4	42.9	60.2	27.1	6.9	...	0.2	7.4	4.2
Unidentified decays	775	86.8	31.9	33.9	42.7	4.4	0.3	...	0.1	0.1
Gray mold rot	356	82.0	27.8	51.4	36.8	3.1	18.0	0.3	...	6.7
Rhizopus rot	104	56.7	54.8	76.0	16.3	19.2	34.6	1.0	23.1	...

Table 5. Frequency of leading disorders in USDA inspections of Bing and Lambert sweet cherry shipments on the New York market, 1972–1984

Cultivar Disorder	Shipments affected (%)	Number of shipments affected according to incidence class (% fruit)							
		0	1–5	6–10	11–20	21–33	34–50	>50	
Bing (1,577^a)									
Pitting	81.2	297	495	424	292	58	10	1	
Bruise damage	36.8	997	249	229	89	13	0	0	
Soft fruit	35.8	1,012	336	140	72	14	2	1	
Brown discoloration	34.1	1,039	342	133	54	9	0	0	
Unidentified decays	33.6	1,047	521	7	1	1	0	0	
Blue mold rot	32.0	1,057	340	139	28	9	3	1	
Gray mold rot	13.7	1,361	154	35	17	4	3	3	
Scarring	8.8	1,439	124	14	0	0	0	0	
Rhizopus rot	4.2	1,511	47	11	2	2	2	2	
Lambert (308^a)									
Pitting	82.5	54	97	87	56	10	4	0	
Soft fruit	53.2	144	61	50	39	9	1	4	
Bruise damage	37.0	194	47	41	23	3	0	0	
Unidentified decays	36.4	196	111	1	0	0	0	0	
Blue mold rot	28.9	219	59	22	4	3	1	0	
Brown discoloration	23.1	237	45	20	5	1	0	0	
Gray mold rot	16.2	258	39	6	5	0	0	0	
Scarring	15.3	261	44	3	0	0	0	0	
Cracking	12.0	271	26	10	1	0	0	0	
Rhizopus rot	3.6	297	11	0	0	0	0	0	

^aNumber of shipments.

Table 6. Frequency of disorders in USDA inspections of 1,777 strawberry shipments on the New York market, 1972–1984

Disorder	Shipments affected (%)	Number of shipments affected according to incidence class (% fruit)						
		0	1–5	6–10	11–20	21–33	34–50	>50
Gray mold rot	76.1	424	300	408	362	155	76	52
Bruise damage	69.2	547	287	352	406	137	32	16
Soft/leaky fruit	47.9	925	185	223	296	122	22	4
Rhizopus soft rot	12.7	1,551	82	60	40	27	15	2
Unidentified decays	9.4	1,610	134	11	10	3	3	6
Leather rot	6.9	1,654	53	30	27	9	3	1
Freeze damage	4.0	1,706	3	5	15	7	13	28
Miscellaneous rots ^a	1.4	1,752	7	4	4	4	5	1
Other ^b	1.6	1,749	10	6	4	6	0	2

^aBlue mold rot, Sclerotium rot, Rhizoctonia rot, and bacterial soft rot.

^bInsect injury and misshapen, crushed, pitted, or overripe fruit.

domestic shipments. Levels of brown discoloration were high in both domestic (34%) and Chilean (22%) cherry shipments.

Disorders reported most frequently with the important parasitic diseases are shown in Table 4. Pitting was most common. Soft fruit was also highly associated with parasitic diseases, a relationship to be expected in deteriorating fruit quality. Brown discoloration and bruise damage were the other

principal disorders. Multiple infections were most frequent when Rhizopus rot was present.

Inspections of shipments of the two most important sweet cherry cultivars, Bing and Lambert, revealed no major differences in occurrences of the leading disorders (Table 5). Soft fruit was more prevalent in Lambert cherry shipments, however, and brown discoloration was more prevalent in Bing

Table 7. Parasitic diseases associated with other disorders in USDA inspections of 1,777 strawberry shipments on the New York market, 1972–1984

Disease	Shipments affected (no.)	Prevalence of disorders					
		Bruise damage (%)	Soft/leaky fruit (%)	Gray mold rot (%)	Rhizopus soft rot (%)	Unidentified decays (%)	Leather rot (%)
Gray mold rot	1,353	68.9	51.1	...	8.1	1.3	5.6
Rhizopus soft rot	226	69.0	53.5	48.7	...	2.2	4.0
Unidentified decays	167	70.7	42.5	10.2	3.0	...	0.6
Leather rot	101	72.3	46.5	74.3	8.9	1.0	...

cherry shipments. Unidentified decays, blue mold rot, gray mold rot, and Rhizopus rot were reported in descending order of occurrence, with only minor differences observed between the two cultivars for each disease.

Strawberries. Federal inspectors examined 1,777 strawberry shipments, or about 6% of all strawberry deliveries to the New York market during 1972–1984. Of the 17 disorders reported, nine were parasitic, four were physiological, and four were injuries (Table 6). Gray mold rot was the most common as well as the most damaging condition found. It occurred in 76% of the strawberry shipments, and levels were high in all incidence classes. Gray mold had rotted more than 10% of the fruit in almost half (645) of the affected shipments. Rhizopus soft rot (13%) and unidentified decays (10%) were next in occurrence of the parasitic diseases. Leather rot (*Phytophthora cactorum*) was reported in 7% of the shipments. Rots caused by species of *Rhizoctonia*, *Penicillium*, *Sclerotium*, and bacteria were reported infrequently.

Bruise damage and soft/leaky fruit were the principal nonparasitic disorders, reported in 70 and 48% of the strawberry inspections, respectively (Table 6). The softness or leaking may have resulted from overmaturity, high temperatures, rots, freezing, or mechanical injury. Misshapen, pitted, or overripe berries were reported in relatively few shipments. In 41 shipments, more than one-third of the fruits were damaged by freezing. A few instances of insect injury and crushing were also reported.

The number of disorders reported in an inspection of a strawberry shipment averaged 2.4. A disease, usually gray mold rot, was commonly associated with bruise damage and/or soft/leaky fruit (Table 7). Gray mold was usually involved when infections were multiple.

Summary. The arrival condition of sweet cherry and strawberry shipments to the New York market reported in USDA inspections during 1972–1984, although not representative of the condition of all arrivals of these crops, does disclose representative disorders of cherry and strawberry crops on the market and their incidence.

With the advent of improved precooling practices (12) and fungicides, the incidence of some postharvest diseases, e.g., Rhizopus soft rot on strawberries, has declined substantially in recent years. That of gray mold rot, however, appears relatively unaffected. The USDA inspections indicate that gray mold rot is still the most serious parasitic disease of strawberries and a common one of sweet cherries on the market. This disease is usually more prevalent when cool, moist weather occurs before harvest (13). Although gray mold rot frequently originates in the field, bruises and skin breaks resulting from harvesting and packaging of the fruits doubtlessly contribute to postharvest infections. The cracking of sweet cherries that follows high moisture conditions in the orchard also permits opportunistic fungi such as *Penicillium* to infect the fruit.

Despite preharvest and postharvest applications of fungicides and the employment of high carbon dioxide atmospheres to reduce decay in transit, substantial losses in product and nutritive quality occur in the marketing of sweet cherries and strawberries (3,4,12,14). The careful handling of

these highly perishable crops during harvesting and subsequent marketing is necessary if product quality is to be maintained. That such practices are apparently not always conscientiously followed can be deduced from the high incidences of disorders that are directly or indirectly related to mechanical injury. Strict adherence to careful handling and more innovative concepts in packaging, to better protect the product, are required before product and quality losses of these important fruit crops can be reduced.

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