

Disorders in Citrus Shipments to the New York Market, 1972-1984

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Citrus leads all fresh fruits delivered to terminal markets in volume and in value (11). Orange (*Citrus sinensis* (L.) Osb.), grapefruit (*C. paradisi* Macf.), and lemon (*C. limon* (L.) Burm. f.) shipments to metropolitan New York annually average about 120,000, 68,000, and 30,000 t, respectively (10,11). California supplies about 85% of the lemons and 60% of the oranges, and Florida supplies about 90% of the grapefruit and 36% of the oranges.

Receivers and shippers, who pay for the service, often request the U.S. Department of Agriculture to inspect fresh produce shipments to determine if grade and quality standards are met. Access to the certificates on which the results of such inspections are recorded has enabled us to establish a computerized data bank on the arrival condition of fresh produce at the New York market. This report, a continuation of a series (1,2,5-8), was prepared from data abstracted from USDA inspection certificates on the arrival condition of oranges, grapefruit, and lemons at the New York market during 1972-1984.

USDA personnel named or described 17 parasitic diseases, 12 physiological disorders, and 7 types of injuries in the inspections of 9,104 orange shipments, 4,910 grapefruit shipments, and 1,239 lemon shipments on the New York market during 1972-1984 (Tables 1-4). Rind breakdown was the leading disorder in each of the three citrus crops, but parasitic

diseases were the most damaging. Rind breakdown, generally caused by aging or injury, has a much higher tolerance (10%) than decay (3%) to meet U.S. No. 1 grade standards. Most of the decays were unidentified, but about two-thirds of these were in the lowest incidence class, affecting only 1% of the fruit in a shipment.

Blue mold rot (*Penicillium italicum*), the most damaging of the identifiable diseases, was reported in more than 20% of the citrus shipments, many with incidences exceeding 5% (Tables 2-4). Sour rot (*Geotrichum candidum*), in about 9% of all shipments, and green mold rot (*P. digitatum*), in 8%, were next in importance and were similarly distributed throughout the incidence classes. Some green mold rots may have been mistakenly identified as blue mold rots because the characteristic spore color of both molds is easily misjudged, especially during nighttime inspections. Mistaking these two diseases for each other, however, does not detract from the dominance of the *Penicillium* rots, which affected about 30% of all shipments. Furthermore, a considerable number of the unidentified decays probably were caused by *Penicillium* spp. Federal inspectors often do not name a disease when grade tolerance is met or when the characteristic symptom expression is not fully developed or recognized.

Stem-end rot (*Diplodia natalensis* and *Phomopsis citri*) was reported in about 5% of shipments, occurring more frequently in grapefruit and oranges than in lemons (Tables 2-4). Of lesser importance were gray mold rot (*Botrytis cinerea*) and brown rot (*Phytophthora* spp.), reported in 1.3 and 0.4% of shipments, respectively. Scab (*Elsinoë fawcettii*) and Alternaria or black rot (*A. citri*) were among several other diseases noted infrequently.

Contact spot was reported in one-third of the lemon

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Table 1. Volumes of oranges, grapefruit, and lemons in shipments inspected by USDA on the New York market, 1972-1984

Year	Oranges		Grapefruit		Lemons	
	Shipments (no.)	Packs ^a (no.)	Shipments (no.)	Packs ^b (no.)	Shipments (no.)	Packs ^c (no.)
1972	859	874,366	265	202,729
1973	730	949,426	401	282,712	18	18,764
1974	987	1,011,206	502	355,107	24	18,924
1975	1,181	1,129,563	967	662,164	265	273,515
1976	1,058	1,211,734	647	491,599	132	126,804
1977	791	1,055,411	232	153,200	37	34,719
1978	607	728,645	190	148,731	68	67,594
1979	471	405,757	239	194,200	72	59,205
1980	619	638,954	212	162,404	60	55,411
1981	127	125,299	173	137,330	46	34,718
1982	386	306,572	359	242,995	54	44,517
1983	669	647,533	340	231,649	166	153,869
1984	619	584,523	383	249,513	297	327,243
Total	9,104	9,668,989	4,910	3,514,333	1,239	1,215,283

^a Net weight per pack, 17.3, 19.1, 19.1, and 19.5 kg for Texas, Arizona, California, and Florida, respectively.

^b Net weight per pack, 18.2 kg for Florida and Texas and 15.4 kg for California and Arizona.

^c Net weight per pack, 17.3 or 19.1 kg.

Table 2. Frequency of disorders reported in USDA inspections of 9,104 orange shipments on the New York market, 1972-1984

Disorder	Shipments affected (%)	Number of shipments affected according to incidence class (%)										
		0	1	2-5	6-10	11-15	16-20	21-25	26-33	34-50	51-75	>75
Rind breakdown	80.8	1,746	728	3,439	1,698	823	398	128	92	39	12	1
Unidentified decays	37.1	5,727	2,391	930	41	10	2	1	0	1	0	1
Scarring	23.6	6,959	76	1,290	752	19	6	0	2	0	0	0
Blue mold rot	22.7	7,035	108	1,351	483	79	27	12	5	3	0	1
Sour rot	9.1	8,278	46	598	144	22	9	3	1	3	0	0
Green mold rot	7.2	8,448	27	437	145	22	10	2	9	2	1	1
Stem-end rot	5.1	8,644	29	291	115	18	3	1	0	3	0	0
Bruising	4.8	8,671	75	225	65	35	19	8	4	1	0	1
Creasing	2.8	8,846	32	192	33	1	0	0	0	0	0	0
Oleocellosis	2.8	8,847	33	194	30	0	0	0	0	0	0	0
Misshapen fruit	1.8	8,941	12	129	19	1	2	0	0	0	0	0
Gray mold rot	1.4	8,974	9	92	22	5	2	0	0	0	0	0
Soft fruit	0.7	9,041	8	43	6	4	0	0	2	0	0	0
Sunburn	0.7	9,043	2	46	11	2	0	0	0	0	0	0
Brown rot	0.5	9,061	0	29	7	6	1	0	0	0	0	0
Scale injury	0.4	9,071	7	25	1	0	0	0	0	0	0	0
Miscellaneous ^a	1.3	8,988	6	68	21	6	5	1	0	4	4	1

^a Scab, contact spot, pitting, freeze damage, insect damage, Alternaria rot, water spot, black rot, melanose, shriveling, cottony rot, Sclerotium rot, stylar-end breakdown, mite russeting, puffiness, and cuts/punctures.

Table 3. Frequency of disorders reported in USDA inspections of 4,910 grapefruit shipments on the New York market, 1972-1984

Disorder	Shipments affected (%)	Number of shipments affected according to incidence class (%)										
		0	1	2-5	6-10	11-15	16-20	21-25	26-33	34-50	51-75	>75
Rind breakdown	63.7	1,782	567	1,813	543	134	47	6	13	4	1	0
Unidentified decays	32.5	3,315	1,006	545	38	3	3	0	0	0	0	0
Blue mold rot	18.3	4,011	34	584	228	39	10	2	1	0	1	0
Scarring	14.7	4,189	39	456	213	10	3	0	0	0	0	0
Green mold rot	7.0	4,566	18	233	77	14	1	1	0	0	0	0
Sour rot	6.8	4,576	17	219	79	13	3	1	0	1	1	0
Stem-end rot	6.3	4,601	24	174	80	26	2	2	1	0	0	0
Bruising	4.7	4,680	43	134	32	14	3	2	2	0	0	0
Gray mold rot	1.1	4,858	4	32	11	4	1	0	0	0	0	0
Misshapen fruit	0.6	4,879	0	30	1	0	0	0	0	0	0	0
Soft fruit	0.5	4,887	3	17	1	2	0	0	0	0	0	0
Scale injury	0.3	4,893	4	12	0	1	0	0	0	0	0	0
Water spot	0.3	4,896	9	3	2	0	0	0	0	0	0	0
Oleocellosis	0.2	4,898	0	10	2	0	0	0	0	0	0	0
Miscellaneous ^a	0.6	4,880	1	23	3	2	0	1	0	0	0	0

^a Melanose, scab, Sclerotium rot, brown rot, Alternaria rot, Fusarium rot, pitting, creasing, cuts/punctures, insect damage, puffiness, and surface discoloration.

Table 4. Frequency of disorders reported in USDA inspections of 1,239 lemon shipments on the New York market, 1973-1984

Disorder	Shipments affected (%)	Number of shipments affected according to incidence class (%)										
		0	1	2-5	6-10	11-15	16-20	21-25	26-33	34-50	51-75	>75
Rind breakdown	51.3	604	156	353	89	28	7	1	0	1	0	0
Unidentified decays	34.5	812	289	131	5	0	2	0	0	0	0	0
Contact spot	34.1	817	59	211	116	22	11	2	1	0	0	0
Blue mold rot	23.8	944	13	184	86	7	4	0	0	0	1	0
Sour rot	22.5	960	21	213	41	1	2	1	0	0	0	0
Green mold rot	21.9	968	13	194	53	7	2	1	1	0	0	0
Scarring	16.9	1,030	22	141	39	3	2	0	1	1	0	0
Oleocellosis	4.1	1,188	11	29	8	1	1	0	0	1	0	0
Misshapen fruit	2.7	1,205	10	18	5	0	1	0	0	0	0	0
Stem-end rot	2.5	1,208	2	28	1	0	0	0	0	0	0	0
Gray mold rot	1.5	1,220	1	15	3	0	0	0	0	0	0	0
Brown rot	0.5	1,233	0	0	1	3	2	0	0	0	0	0
Miscellaneous ^a	2.3	1,211	3	17	3	2	2	1	0	0	0	0

^a Alternaria rot, soft rot, Cladosporium rot, black pit, stylar-end breakdown, sunburn, creasing, granulation, bruising, freeze damage, puffiness, scale injury, and soft fruit.

Table 5. Frequency of parasitic diseases reported in USDA inspections of orange shipments from California and Florida on the New York market, 1972–1984

Source Disease	Shipments affected (%)	Number of shipments affected according to incidence class (%)										
		0	1	2-5	6-10	11-15	16-20	21-25	26-33	34-50	51-75	>75
California (4,382 ^a)												
Unidentified decays	41.9	2,547	1,354	464	15	2	0	0	0	0	0	0
Blue mold rot	21.3	3,450	51	652	187	23	9	5	1	3	0	1
Green mold rot	8.3	4,017	15	249	83	10	3	1	1	1	1	1
Sour rot	8.3	4,017	32	282	45	3	1	1	1	0	0	0
Gray mold rot	1.1	4,332	5	39	4	2	0	0	0	0	0	0
Stem-end rot	1.0	4,337	9	28	6	2	0	0	0	0	0	0
Brown rot	0.5	4,359	0	22	1	0	0	0	0	0	0	0
Miscellaneous ^b	0.8	4,346	7	18	6	2	2	1	0	0		0
Florida (4,310 ^a)												
Unidentified decays	32.6	2,906	951	430	16	7	0	0	0	0	0	0
Blue mold rot	24.6	3,250	52	667	268	46	18	6	3	0	0	0
Sour rot	9.7	3,892	13	288	91	14	8	2	0	2	0	0
Stem-end rot	9.3	3,910	19	258	103	14	3	1	0	2	0	0
Green mold rot	5.9	4,057	11	167	54	11	4	1	5	0	0	0
Gray mold rot	1.7	4,236	3	50	17	2	2	0	0	0	0	0
Scab	0.6	4,284	0	20	6	0	0	0	0	0	0	0
Miscellaneous ^c	0.6	4,286	4	6	7	6	1	0	0	0	0	0

^aNumber of shipments.

^bAlternaria rot, black rot, contact spot, cottony rot, and melanose.

^cAlternaria rot, black rot, brown rot, contact spot, and melanose.

Table 6. Frequency of parasitic diseases reported in USDA inspections of navel and Valencia orange shipments on the New York market, 1972–1984

Type Disease	Shipments affected (%)	Number of shipments affected according to incidence class (%)										
		0	1	2-5	6-10	11-15	16-20	21-25	26-33	34-50	51-75	>75
Navel (3,667 ^a)												
Unidentified decays	43.1	2,087	1,172	390	16	2	0	0	0	0	0	0
Blue mold rot	21.5	2,877	49	555	156	22	2	3	0	3	0	0
Sour rot	8.3	3,361	26	236	36	5	3	0	0	0	0	0
Green mold rot	7.4	3,394	15	185	60	9	2	1	0	0	1	0
Stem-end rot	2.0	3,595	8	46	16	2	0	0	0	0	0	0
Gray-mold rot	1.1	3,627	3	32	4	1	0	0	0	0	0	0
Brown rot	0.6	3,644	0	22	1	0	0	0	0	0	0	0
Other ^b	0.8	3,638	5	20	3	0	1	0	0	0	0	0
Valencia (2,750 ^a)												
Unidentified decays	33.0	1,843	652	246	6	3	0	0	0	0	0	0
Blue mold rot	24.2	2,085	39	428	151	21	20	4	2	0	0	0
Stem-end rot	7.5	2,545	12	134	50	5	1	1	0	2	0	0
Green mold rot	5.1	2,611	6	90	33	2	2	1	3	1	0	1
Sour rot	4.0	2,640	5	79	19	1	1	3	0	2	0	0
Gray mold rot	2.0	2,696	4	37	10	3	0	0	0	0	0	0
Other ^c	1.3	2,713	4	22	11	0	0	0	0	0	0	0

^aNumber of shipments.

^bBlack rot, Alternaria rot, cottony rot, melanose, and contact spot.

^cScab, Alternaria rot, brown rot, Sclerotium rot, and melanose.

Table 7. Leading disorders in USDA inspections of grapefruit shipments on the New York market, 1972–1984

Grapefruit type	Shipments (no.)	Rind breakdown (%)	Unidentified decays (%)	Blue mold rot (%)	Scarring (%)	Green mold rot (%)	Sour rot (%)	Stem-end rot (%)	Bruising (%)	Gray mold rot (%)
White-fleshed, seedless	217	65.9	32.3	24.0	25.3	6.0	7.4	7.4	6.0	1.4
Pink-fleshed	1,762	59.6	31.7	16.3	11.0	7.0	7.4	6.2	4.0	0.5
Pink-fleshed, seedless	130	67.7	30.8	26.9	22.3	5.4	4.6	10.8	6.2	2.3
Unknown	466	73.4	31.3	25.2	32.5	4.5	1.9	6.6	7.8	2.1

shipments (Table 4). In this disorder, decayed tissue fragments or mold adhere to lemons in contact with rotted fruit (usually infected with green mold) within a pack. Many contact spots are or become incipient infections that rot the fruit during subsequent marketing.

Scarring was one of the most prevalent nonparasitic disorders and was noted in about 20% of the shipments (Tables 2-4). Other nonparasitic disorders of importance were bruising (about 4%), and oleocellosis, creasing, and misshapen fruit (each about 2%). Oleocellosis (oil spot), more common in lemons than in oranges or grapefruit, occurs when mechanical injury ruptures the oil glands in the rind; this is most likely to happen when the fruit is handled while wet or turgid (9). Creasing, characterized by narrow, sunken furrows or irregular grooves in the rind (9), was reported in about 3% of orange shipments. Water spot, normally associated with navel oranges, was reported in some grapefruit shipments; the common expression was a water-soaked condition of the rind at or near the calyx end of the fruit. As with rind breakdown, these nonparasitic disorders, individually or collectively, have a U.S. No. 1 grade tolerance level of 10%.

Major disorders reported in orange shipments from California and Florida, the chief suppliers of that fruit, were similar (Table 5). One exception was stem-end rot, which occurred much more frequently in fruit from Florida; the disease is associated with the abundant rainfall, high humidities, and low nighttime temperatures that ordinarily prevail in the Florida growing areas. Brown rot was more common in orange shipments from California, whereas scab was reported only in Florida shipments.

Table 6 gives the parasitic disease data obtained from a substantial number of inspections of the principal orange types, navel and the cultivar Valencia. Major disease patterns were generally similar. Brown rot and sour rot were more frequent in navel oranges, and stem-end rot was more common in Valencia oranges.

Table 7 lists the leading disorders reported in inspections of white-fleshed and pink-fleshed grapefruit. No essential differences in types or frequencies of disorders were observed.

USDA inspections are usually conducted because receivers question quality standards, so the information in this report does not represent the arrival condition of all orange, grapefruit, and lemon shipments to the New York market during 1972-1984. We believe, however, that the inspection reports provide an accurate appraisal of disease problems in the marketing of these fruits. During the 13-year inspection period,

trained USDA personnel inspected a minimum of six packs in each of 15,253 shipments, representing about 6% of the lemons and grapefruit and about 10% of the oranges delivered to the New York market. That blue mold rot may have been mistaken for green mold rot and vice versa, and *Penicillium* rot may have been mistaken for *Trichoderma* rot (*T. viride*), should not affect the overall appraisal.

As the fruits move through the marketing channels, additional deterioration at the retail and consumer levels can be expected (3,4). We hope this report provides citrus industry workers with information that facilitates measures for controlling postharvest diseases more effectively and for reducing product losses in the marketing of these major commodities.

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