

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

R. A. CAPPELLINI, Professor of Plant Pathology, Rutgers University, New Brunswick, NJ 08903; M. J. CEPONIS, Research Plant Pathologist, Agricultural Research Service, U.S. Department of Agriculture, New Brunswick, NJ 08903; and G. W. LIGHTNER, Computer Specialist, West Virginia University, Appalachian Fruit Research Station, Kearneysville, WV 25430

Table grapes (*Vitis vinifera* L.) are among the 10 major fruit and vegetable crops delivered to the New York metropolitan area. Commercial production of table grapes in the United States is largely limited to California; the principal foreign source is Chile.

During 1972-1984, some 485,636 t of table grapes were shipped to the New York market (Table 1), 55% by railcar and the rest by truck-trailer (9,10). About 84% of this volume was from California, 13% from Chile, and the remainder principally from Arizona, Mexico, Italy, and South Africa.

This report is another in a series (2-6) describing the arrival condition of major fresh produce crops on the New York market. The statistics on table grapes were abstracted from a computerized data bank containing information on 30 major fruit and vegetable crops from more than 125,000 inspection certificates provided by the Fresh Products Branch of the USDA Agricultural Marketing Service in New York City. The inspections were made by federal employees trained to diagnose disorders by symptomatology; some final diagnoses were made by market pathologists. The data presented here were obtained from inspections of table grape shipments to the New York market during 1972-1984. The major cultivars were Thompson Seedless, Emperor, and Ribier; of lesser importance were Calmeria, Perlette, Almeria, and Cardinal.

More than 8,000 shipments were inspected (Table 2), or about 17% of the total volume of grapes shipped to the New York market. Grapes are generally shipped in wooden boxes (lugs), with net weights usually 23 lb but ranging from 14 to 23 lb. A minimum of six boxes of grapes, selected at random, were inspected in each shipment; additional boxes were inspected if the receiver or shipper requested a more extensive evaluation of the condition of the load.

Of the 30 disorders reported by federal inspectors, 6 were characterized as parasitic diseases, 15 as physiological disorders, and 9 as injuries (Table 3). Gray mold rot was the most important parasitic disease, detected in 32.5% of the shipments. This disease occurs in all grape-growing areas of the world and is one of the principal decays during storage and marketing of grapes (7,8). The causal organism (*Botrytis cinerea*) can grow and develop at 0 C and is routinely controlled with sulfur dioxide (SO₂) fumigation during storage and transit. Unidentified decays occurred in 35% of the shipments; blue mold rot (*Penicillium* spp.) and Rhizopus rot (*R. nigricans*) were of lesser importance.

The chief nonparasitic disorders were shattering (47% of inspected shipments) and wet/sticky berries (42%). Shattering, in which berries separate from the cluster, is a significant factor in grape losses at the retail level (1). Thompson Seedless is a particularly susceptible cultivar, whereas Emperor and Ribier are more resistant (8). Although rough handling during picking,

packing, and shipping causes some shattering, certain cultural practices and environmental conditions during growth are believed to be important factors influencing the disorder (8). Wet/sticky berries are associated with crushing, advanced decay, freeze damage, and/or SO₂ injury. Freeze-damaged grapes are generally soft, flaccid, and dull-appearing. After a severe freeze, the fruit is water-soaked because of cellular disruption and the surface becomes wet and sticky; tissues turn gray or brown. SO₂ injury results in bleached or discolored fruit, usually at the stem end but also at skin breaks. In some cultivars, SO₂ may cause pitting over the berry surface (7,8).

Other important nonparasitic disorders were brown discoloration (20% of inspected shipments), shot berry (11%), and shriveling (6%). Several factors, such as surface freezing, pressure bruising, and unfavorable growing conditions, cause brown discoloration, which is chiefly superficial. Shot berry describes small, poorly developed berries and is probably due to poor pollination (7). Although these berries normally are trimmed out before packing, the condition was reported in a substantial number of shipments. Desiccation usually occurs during storage, resulting in shriveling, particularly near the capstems; temperature, humidity, and maturity affect susceptibility to desiccation (8). Raisining, water berry, and sunken discoloration were each reported in about 2% of inspected shipments.

Crushing was the principal mechanical injury (34% of inspected shipments), followed by scarring (24%). Scarring, a general term applied to various kinds of marks or spots on the fruit, may be caused by mechanical injuries during production, by insects, and/or by hail (7).

Table 4 shows the distribution of the most frequently reported grape disorders according to incidence class. Gray mold rot was the only parasitic disease of economic importance

Table 1. Volume of table grapes shipped to the New York market, 1972-1984

Year	Number of 45,400-kg units shipped			Total
	California	Chile	Other ^a	
1972	757	174	42	973
1973	780	163	29	972
1974	660	225	23	908
1975	838	208	30	1,076
1976	681	65	18	764
1977	545	47	35	627
1978	421	62	18	501
1979	505	48	15	568
1980	600	55	11	666
1981	626	47	9	682
1982	870	108	13	991
1983	810	116	18	944
1984	894	11	7	1,012
Total	8,987	1,429	268	10,684

^a Principally Arizona, Mexico, Italy, and South Africa.

This report was supported in part by the New Jersey Agricultural Experiment Station and Hatch Act funds under N.J.A.E.S. Project 11120.

The publication costs of this article were defrayed in part by page charge payment. This article must therefore be hereby marked "advertisement" in accordance with 18 U.S.C. § 1734 solely to indicate this fact.

Table 2. Table grape shipments inspected by USDA on the New York market, 1972–1984

Year	Railcar		Truck-trailer		Other ^a		Total	
	Shipments (no.)	Packs ^b (no.)	Shipments (no.)	Packs (no.)	Shipments (no.)	Packs (no.)	Shipments (no.)	Packs (no.)
1972	335	240,781	755	708,434	18	30,352	1,108	979,567
1973	249	191,555	269	238,848	7	3,167	525	433,570
1974	162	128,207	216	205,131	1	278	379	333,616
1975	256	358,410	912	903,138	366	987,370	1,524	2,248,918
1976	35	35,950	810	813,982	27	53,411	872	903,343
1977	50	47,338	615	507,330	187	388,981	852	943,649
1978	2	4,320	136	114,547	5	3,468	143	122,335
1979	8	9,346	258	233,840	4	1,540	270	244,726
1980	39	49,670	350	311,407	8	3,940	397	365,017
1981	3	4,688	57	34,851	3	692	63	40,231
1982	6	6,616	88	84,562	42	30,846	136	122,024
1983	50	54,143	524	558,046	161	153,275	735	765,464
1984	60	55,658	705	707,576	321	283,329	1,086	1,046,563
Total	1,255	1,186,682	5,695	5,421,692	1,150	1,940,649	8,100	8,549,023

^a Air (23), boat (639), and lot (488, partial or whole unloads inspections).^b Usually 23 lb but ranging from 14 to 23 lb.**Table 3.** Disorders reported in USDA inspections of 8,100 table grape shipments on the New York market, 1972–1984

Parasitic diseases	Shipments (no.)	Physiological disorders	Shipments (no.)	Injuries	Shipments (no.)
Unidentified decays	2,840	Shattering	3,833	Crushing	2,728
Gray mold rot	2,629	Wet/sticky berries ^a	3,424	Scarring	1,965
Blue mold rot	122	Brown discoloration	1,602	Grade defects ^b	1,341
Rhizopus rot	29	Shot berry	878	Freeze damage	120
Other ^c	3	Shriveling	515	SO ₂ injury	92
		Raisining	180	Insect damage	31
		Water berry	144	Bruising	22
		Sunken discoloration	135	Other ^d	8
		Internal browning	120		
		Soft	64		
		Almeria spot	24		
		Other ^e	15		

^a Often associated with advanced decay, crushing, freeze damage, and/or SO₂ injury.^b Minor bruises, immaturity, poor color, soil/debris, etc.^c Black measles and stem-end rots.^d Sun and chemical spray injuries.^e Cracking, discolored, misshapen, and skin breakdown.**Table 4.** Frequency of leading disorders reported in USDA inspections of 8,100 table grape shipments on the New York market, 1972–1984

Disorder	Number of shipments affected according to incidence class (% fruit)										
	0	1	2-5	6-10	11-15	16-20	21-25	26-33	34-50	51-75	>75
Shattering	4,267	680	2,014	937	162	19	12	4	5	0	0
Wet/sticky berries	4,676	547	1,771	773	196	71	23	25	13	5	0
Crushing	5,372	876	1,515	242	45	18	10	10	9	1	2
Unidentified decays	5,260	2,716	104	17	2	0	0	0	0	1	0
Gray mold rot	5,471	208	1,908	351	71	31	12	16	18	4	10
Scarring	6,135	186	1,546	229	4	0	0	0	0	0	0
Brown discoloration	6,498	195	902	368	77	33	12	10	3	1	1
Grade defects	6,759	149	1,018	172	2	0	0	0	0	0	0
Shot berry	7,222	159	576	122	12	7	0	0	0	2	0
Shriveling	7,585	39	313	130	18	7	1	6	1	0	0
Raisining	7,920	20	97	30	17	14	1	1	0	0	0
Water berry	7,956	48	90	6	0	0	0	0	0	0	0
Sunken discoloration	7,965	20	82	26	6	0	0	1	0	0	0
Blue mold rot	7,978	16	80	18	2	2	1	1	2	0	0
Freeze damage	7,980	0	10	12	20	14	11	10	15	4	24
Internal browning	7,980	20	70	17	9	3	1	0	0	0	0
SO ₂ injury	8,008	24	47	12	3	1	1	1	3	0	0

and was reported in all incidence classes. About 20% of affected shipments had more than 5% decay; 32 shipments had one-third or more of the contents rotted and probably were not salvageable. Although unidentified decays were noted more frequently than gray mold rot, over 95% were in the 1% incidence class. When the incidence of decay was 1% or lower

and within grade tolerance, inspectors often did not identify the cause; many such instances probably were early, undetectable stages of gray mold rot.

Shattering, wet/sticky berries, brown discoloration, shot berry, and shriveling were the most damaging physiological disorders, not only in occurrences but also in incidences.

Table 5. Disorders reported most frequently in USDA inspections of shipments of leading table grape cultivars on the New York market, 1972-1984

Cultivar	No. of shipments	Disorders and percentage of shipments affected						
		Shattering	Wet/sticky berries	Gray mold	Brown discoloration	Unidentified decays	Scarring	Crushing
Thompson Seedless	2,848	72.5	39.8	34.6	36.7	38.1	32.1	28.8
Emperor	1,736	25.7	40.7	29.4	2.1	32.0	15.4	24.8
Ribier	1,225	27.0	56.5	27.8	0.7	36.4	23.5	62.0
Calmeria	510	32.5	24.1	27.3	21.6	35.7	15.7	13.1
Perlette	265	63.8	22.2	31.4	53.8	34.5	30.3	20.7
Almeria	211	17.5	29.9	41.2	12.8	22.8	18.5	19.0
Cardinal	197	37.6	46.7	31.5	3.0	33.5	19.3	46.2

Table 6. Frequency of leading disorders reported in USDA inspections of 6,447 table grape shipments from California on the New York market, 1972-1984

Disorder	Number of shipments affected according to incidence class (% fruit)										
	0	1	2-5	6-10	11-15	16-20	21-25	26-33	34-50	51-75	>75
Shattering	3,271	615	1,661	741	129	12	9	4	5	0	0
Wet/sticky berries	3,507	486	1,494	658	175	68	19	23	12	5	0
Crushing	3,998	777	1,370	214	41	18	10	10	8	1	0
Unidentified decays	3,987	2,354	91	13	1	0	0	0	0	1	0
Gray mold rot	4,435	140	1,494	251	53	23	10	13	15	4	9
Scarring	4,848	147	1,249	199	4	0	0	0	0	0	0
Brown discoloration	5,252	168	691	244	53	24	5	5	3	1	1
Grade defects	5,305	125	864	151	2	0	0	0	0	0	0
Shot berry	5,731	129	463	107	10	7	0	0	0	0	0
Shriveling	6,027	36	275	85	13	5	1	4	1	0	0
Raisining	6,276	17	91	30	17	14	1	1	0	0	0
Water berry	6,326	45	72	4	0	0	0	0	0	0	0
Freeze damage	6,343	0	10	11	15	10	7	10	14	4	23
Blue mold rot	6,357	11	61	11	2	1	1	1	2	0	0
SO ₂ injury	6,360	24	43	11	3	1	1	1	3	0	0
Sunken discoloration	6,361	10	55	16	4	0	0	1	0	0	0
Internal browning	6,347	19	61	13	6	1	0	0	0	0	0
Rhizopus rot	6,430	4	2	6	2	0	0	3	0	0	0

Table 7. Frequency of leading disorders reported in USDA inspections of 1,083 table grape shipments from Chile on the New York market, 1972-1984

Disorder	Number of shipments affected according to incidence class (% fruit)										
	0	1	2-5	6-10	11-15	16-20	21-25	26-33	34-50	51-75	>75
Gray mold rot	671	55	260	70	14	7	1	3	1	0	1
Shattering	683	47	196	122	30	5	0	0	0	0	0
Wet/sticky berries	790	36	160	83	11	1	2	0	0	0	0
Scarring	861	34	181	7	0	0	0	0	0	0	0
Brown discoloration	884	18	99	62	11	3	6	0	0	0	0
Unidentified decays	885	190	7	1	0	0	0	0	0	0	0
Crushing	935	50	80	18	0	0	0	0	0	0	0
Grade defects	922	19	69	3	0	0	0	0	0	0	0
Shriveling	1,004	3	27	40	5	2	0	2	0	0	0
Shot berry	1,028	28	27	0	0	0	0	0	0	0	0
Sunken discoloration	1,062	0	15	6	0	0	0	0	0	0	0
Blue mold rot	1,064	1	12	5	0	1	0	0	0	0	0
Internal browning	1,074	0	4	1	2	1	1	0	0	0	0
Water berry	1,078	2	1	2	0	0	0	0	0	0	0

Table 8. Frequency of leading disorders reported in USDA inspections of 4,693 shipments from California of table grape cultivars Thompson Seedless, Emperor, and Ribier on the New York market, 1972–1984

Cultivar Disorder	Number of shipments affected according to incidence class (% fruit)										
	0	1	2-5	6-10	11-15	16-20	21-25	26-33	34-50	51-75	>75
Thompson Seedless (2,119^a)											
Shattering	494	77	874	562	99	7	3	3	0	0	0
Wet/sticky berries	1,234	151	525	159	28	13	6	2	1	0	0
Unidentified decays	1,214	868	32	5	0	0	0	0	0	0	0
Brown discoloration	1,338	128	479	132	24	10	3	2	2	0	1
Gray mold rot	1,491	34	505	68	13	5	0	1	0	0	2
Shot berry	1,789	18	213	90	9	0	0	0	0	0	0
Shriveling	2,000	9	93	14	2	1	0	0	0	0	0
SO ₂ injury	2,071	19	27	2	0	0	0	0	0	0	0
Emperor (1,566^a)											
Wet/sticky berries	880	144	309	165	53	11	0	2	1	1	0
Unidentified decays	1,038	513	11	4	0	0	0	0	0	0	0
Gray mold rot	1,083	29	351	76	10	9	2	0	2	4	0
Shattering	1,139	221	191	10	3	0	0	1	1	0	0
Shriveling	1,449	16	69	25	2	2	0	3	0	0	0
Shot berry	1,465	39	61	0	1	0	0	0	0	0	0
Brown discoloration	1,535	6	18	7	0	0	0	0	0	0	0
SO ₂ injury	1,546	2	9	3	1	1	1	1	2	0	0
Ribier (1,008^a)											
Wet/sticky berries	380	97	306	155	39	19	5	6	1	0	0
Unidentified decays	605	384	16	3	0	0	0	0	0	0	0
Shattering	701	158	130	12	1	1	3	0	2	0	0
Gray mold rot	722	25	226	28	3	1	0	0	3	0	0
Shot berry	911	43	53	0	0	1	0	0	0	0	0
Shriveling	923	6	48	23	7	1	0	0	0	0	0
Blue mold rot	992	3	12	0	0	0	0	0	1	0	0
Raisining	992	1	9	3	0	1	1	1	0	0	0
SO ₂ injury	1,003	0	3	2	0	0	0	0	0	0	0

^aNumber of shipments inspected.

Table 9. Frequency of leading disorders reported in USDA inspections of 874 shipments from Chile of table grape cultivars Thompson Seedless, Emperor, and Ribier on the New York market, 1972–1984

Cultivar Disorder	Number of shipments affected according to incidence class (% fruit)										
	0	1	2-5	6-10	11-15	16-20	21-25	26-33	34-50	51-75	>75
Thompson Seedless (521^a)											
Shattering	200	17	157	114	30	3	0	0	0	0	0
Gray mold rot	242	35	170	53	9	6	1	3	1	0	1
Wet/sticky berries	346	18	102	46	7	1	1	0	0	0	0
Brown discoloration	360	12	86	47	8	2	6	0	0	0	0
Unidentified decays	423	93	4	1	0	0	0	0	0	0	0
Shot berry	470	26	25	0	0	0	0	0	0	0	0
Shriveling	475	0	17	24	1	2	0	2	0	0	0
Emperor (163^a)											
Unidentified decays	135	28	0	0	0	0	0	0	0	0	0
Gray mold rot	139	4	17	0	2	1	0	0	0	0	0
Wet/sticky berries	144	3	8	6	1	0	1	0	0	0	0
Shattering	148	10	4	1	0	0	0	0	0	0	0
Shriveling	155	0	2	4	2	0	0	0	0	0	0
Brown discoloration	159	1	2	1	0	0	0	0	0	0	0
Blue mold rot	161	0	1	1	0	0	0	0	0	0	0
Ribier (190^a)											
Wet/sticky berries	127	10	34	18	1	0	0	0	0	0	0
Gray mold rot	136	11	37	6	0	0	0	0	0	0	0
Unidentified decays	150	39	1	0	0	0	0	0	0	0	0
Shattering	167	11	12	0	0	0	0	0	0	0	0
Shriveling	177	3	6	3	1	0	0	0	0	0	0
Blue mold rot	188	1	1	0	0	0	0	0	0	0	0
Water berry	188	0	0	2	0	0	0	0	0	0	0

^aNumber of shipments inspected.

Crushing was the most serious injury; 95 shipments had more than 10% of the fruit crushed. The incidence of scarring, on the other hand, was almost always 10% or less. Although the number of shipments with freeze damage was relatively low, more than 20% of the fruit was frozen in over one-half of the shipments in which such damage was reported.

Seven grape cultivars accounted for approximately 86% of all inspected shipments (Table 5). The light-colored cultivars, especially Thompson Seedless and Perlette, were particularly susceptible to shattering and brown discoloration. Wet/sticky berries were reported in almost 45% of the shipments of the three leading cultivars; crushing was associated in 70% and gray mold rot in 55%. Crushing was considerably more frequent with Ribier grapes than with the other cultivars. Gray mold rot and unidentified decays occurred with about equal frequency in all cultivars.

About 79% of the inspected shipments were from California (Table 6) and about 14% were from Chile (Table 7). Shattering was the leading disorder in shipments from California and gray mold rot in shipments from Chile. The profile of disorders reported in California shipments is practically identical to that for all inspections because of the dominance of California grapes in the marketplace.

Thompson Seedless, Emperor, and Ribier cultivars accounted for about 73% of the inspected shipments from California (Table 8) and about 81% of those from Chile (Table 9). Shattering was the leading disorder in Thompson Seedless and wet/sticky berries in Ribier from both sources. In Emperor grapes, the leading disorder was wet/sticky berries in shipments from California and unidentified decays in shipments from Chile.

We acknowledge that the information presented here is not wholly representative of the arrival condition of all table grapes on the New York market, since many of the inspections were made at the request of receivers who questioned the condition of shipments because of malfunctioning protective services, transit delays, or some apparent loss of quality. However, the

diagnoses of disorders in approximately 50,000 lugs of grapes were made by trained inspectors over a 13-year period and consequently represent a fairly accurate appraisal of the type and incidence of disorders found in table grapes in the New York marketing area. Furthermore, the inspections provide the table grape industry with valuable information that should be useful in improving quality and reducing serious losses of table grapes during marketing.

ACKNOWLEDGMENT

We thank the New York office of the USDA Fresh Fruit and Vegetable Inspection, Fresh Products Branch of the Agricultural Marketing Service for making available the inspection certificates from which the data for this report were obtained.

LITERATURE CITED

1. Cappellini, R. A., and Ceponis, M. J. 1984. Postharvest losses in fresh fruit and vegetables. Pages 24-31 in: *Postharvest Pathology of Fruits and Vegetables: Postharvest Losses in Perishable Crops*. H. E. Moline, ed. N.E. 87 Bull.
2. Cappellini, R. A., Ceponis, M. J., Wells, J. M., and Lightner, G. W. 1984. Disorders in potato shipments to the New York market, 1972-1980. *Plant Dis.* 68:1018-1020.
3. Ceponis, M. J., Cappellini, R. A., and Lightner, G. W. 1985. Disorders in crisphead lettuce shipments to the New York market, 1972-1984. *Plant Dis.* 69:1016-1020.
4. Ceponis, M. J., Cappellini, R. A., and Lightner, G. W. 1986. Disorders in tomato shipments to the New York market, 1972-1984. *Plant Dis.* 70:261-265.
5. Ceponis, M. J., Cappellini, R. A., and Lightner, G. W. 1986. Disorders in muskmelon shipments to the New York market, 1972-1984. *Plant Dis.* 70:605-607.
6. Ceponis, M. J., Cappellini, R. A., and Lightner, G. W. 1986. Disorders in onion shipments to the New York market, 1972-1984. *Plant Dis.* 70:988-991.
7. Harvey, J. M., and Pentzer, W. T. 1960. Market diseases of grapes and other small fruits. U.S. Dep. Agric. Agric. Mark. Serv. Agric. Handb. 189. 37 pp.
8. Ryall, A. L., and Harvey, J. M. 1959. The cold storage of vinifera table grapes. U.S. Dep. Agric. Agric. Mark. Serv. Agric. Handb. 159. 46 pp.
9. United States Department of Agriculture. 1973-1982. Fresh fruit and vegetable unloads in eastern cities. U.S. Dep. Agric. Agric. Mark. Serv. FVUS-1 (1972-1981).
10. United States Department of Agriculture. 1983-1985. Fresh fruit and vegetable arrivals in eastern cities. U.S. Dep. Agric. Agric. Mark. Serv. FVAS-1 (1982-1984).