

## Disorders in Asparagus, Eggplant, and Snap Bean Shipments to the New York Market, 1972–1985

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The New York City market annually receives about 4,000 t of fresh asparagus, 12,000 t of eggplant, and 13,700 t of snap beans (Table 1). Asparagus, highly prized for its unique flavor and vitamin C content, is supplied principally by California during the spring months and by Chile late in the year. Mexico and Florida are the main suppliers of eggplant. A number of states supply snap beans, with Florida the volume leader (18,19).

This report is another in a series (1–5,7–15) detailing the arrival condition of major fresh produce crops on the New York market. The information was retrieved from a computerized data bank holding data initially abstracted from USDA inspection certificates. The inspections were made by trained USDA personnel who routinely examine six (or more, if needed) purportedly representative packs (cartons, crates, or hampers) of a commodity in a shipment to evaluate quality and identify, by symptomatology, diseases and other disorders affecting grade standards. Identifying the nature and the extent of disorders in arrival shipments of asparagus, eggplant, and snap beans provides the basic knowledge necessary to formulate feasible measures for disease control and the subsequent reduction of market losses.

**Asparagus.** USDA personnel inspected 1,104 shipments whose contents represented 13.0% of the asparagus delivered to New York terminal markets during 1972–1985 (Table 2). Eight parasitic diseases (850 occurrences), seven physiological disorders (697 occurrences), and five types of injury (483 occurrences) were identified or described with the examination of more than 6,500 crates of asparagus (Table 3). Bacterial soft rot (*Erwinia* sp.), spreading of tips, and bruise damage were the most frequently reported parasitic disease, physiological disorder, and injury, respectively.

Bacterial soft rot, reported in 59.4% of the shipments inspected, was distributed from the lowest (1–5% of the spears rotted) to the highest (>50%) incidence class (Table 3). Asparagus tips were affected mostly and butts occasionally. In nearly one-half of the shipments with bacterial soft rot, more than 10% of the examined asparagus was rotted. Those shipments with more than one-third of their contents rotted were probably complete losses. *Phytophthora* rot (*Phytophthora* sp.) and gray mold rot (*Botrytis cinerea*) were reported in 3.6 and 3.3% of the shipments, respectively, with many occurrences in high incidence classes. Unidentified decays were reported in 9.5% of the shipments but nearly all were in the lowest incidence class. Watery soft rot (*Sclerotinia sclerotiorum*), *Fusarium* rot (*Fusarium* sp.), *Rhizopus* rot (*Rhizopus* sp.), and blue mold rot (*Penicillium* sp.) each were reported in less than 1% of the shipments.

Spreading of tips occurred more frequently (42.4%) than any disorder other than bacterial soft rot (Table 3). This condition, symptomatic of overmaturity, was reported mostly in incidence classes affecting up to one-third of a shipment. Bruise damage was reported in 23.6% of the shipments and was almost always

restricted to the tender tips, causing some breakage and providing infection courts for soft rot bacteria. Other nonparasitic disorders causing serious damage were freeze damage (9.8%), shriveling (6.2%), and soft/flaccid spears (1.4%). All occurred at high incidences, with freezing especially damaging. Less damaging were grade defects (9.5%) and a few other disorders, each reported in less than 1% of the shipments.

Table 4 shows important disorders reported on asparagus shipped from main sources of supply. Frequency of occurrence of bacterial soft rot was lower in shipments from California or Washington than in those from Chile or Mexico. The reverse was true for spreading of tips and freeze damage. Bruise damage and shriveling occurred frequently in California and Washington shipments, respectively.

**Eggplant.** USDA inspections were conducted on 1,455 eggplant shipments containing 3.0% of the volume delivered to the New York market. Parasitic diseases accounted for 53% of the 2,828 reported occurrences, physiological disorders for 36%, and injuries for 11% (Table 5). Fruit rot (*Phomopsis vexans*), brown discoloration (scald), and bruise damage were the most frequently reported parasitic disease, physiological disorder, and injury, respectively.

Fruit rot was reported in 70.5% of the inspected shipments, with numerous occurrences ranging from 21% to >50% in a shipment (Table 5). Bacterial soft rot (*Erwinia* sp.), mainly of calyxes, was noted less frequently (21.9%) but had similar distribution. Other diseases of some importance were *Alternaria* rot (*Alternaria tenuis*) and gray mold rot (*B. cinerea*), reported in 3.9 and 1.2% of the shipments,

**Table 1.** Volume of asparagus, eggplant, and snap beans<sup>a</sup> shipped to the New York market, 1972–1985

Year	Number of 45,400-kg units					
	Asparagus		Eggplant		Snap beans	
	Rail	Truck	Rail	Truck	Rail	Truck
1972	28	57	20	195	13	303
1973	42	71	20	262	7	335
1974	17	77	10	265	6	308
1975	12	90	3	308	8	371
1976	5	88	1	267	2	346
1977	1	77	1	251	1	298
1978	0	66	0	244	9	261
1979	0	56	0	240	8	257
1980	0	68	1	275	12	300
1981	8	84	10	322	16	302
1982	8	71	12	272	16	302
1983	15	80	15	265	19	269
1984	21	80	20	228	24	223
1985	18	72	22	177	27	179
Total	175	1,037	135	3,571	168	4,054

<sup>a</sup> Principally green snap beans.

**Table 2.** Shipments of asparagus, eggplant, and snap beans inspected by the USDA on the New York market, 1972–1985

Year	Asparagus		Eggplant		Snap beans <sup>a</sup>	
	Shipments (no.)	Packs <sup>b</sup> (no.)	Shipments (no.)	Packs <sup>c</sup> (no.)	Shipments (no.)	Packs <sup>d</sup> (no.)
1972	64	48,802	91	41,156	54	11,620
1973	70	46,483	122	62,352	51	11,558
1974	57	41,431	79	42,678	30	6,223
1975	76	48,609	63	26,247	63	11,361
1976	65	36,215	89	34,764	49	13,429
1977	29	18,849	63	17,723	45	11,613
1978	38	19,603	63	19,512	35	6,569
1979	28	14,488	50	17,419	30	10,578
1980	48	14,420	96	32,944	93	22,347
1981	74	32,760	130	51,353	97	21,185
1982	84	27,744	131	39,692	128	27,319
1983	146	50,495	147	53,827	220	46,710
1984	152	56,015	198	78,607	255	51,784
1985	173	70,002	133	53,187	145	30,472
Total	1,104	525,916	1,455	571,461	1,295	282,768

<sup>a</sup>Includes 13 inspections of yellow snap bean shipments.<sup>b</sup>Pyramid crates with 13.6 kg net weight.<sup>c</sup>Bushel baskets, cartons, or crates with 15.0 kg net weight.<sup>d</sup>Bushel baskets, cartons, or hampers with 13.6 kg net weight.**Table 3.** Frequency of disorders reported in USDA inspections of 1,104 asparagus shipments<sup>a</sup> on the New York market, 1972–1985

Disorder	Shipments affected (%)	Number of shipments affected according to incidence class (% spears)						
		0	1–5	6–10	11–20	21–33	34–50	>50
Bacterial soft rot	59.4	448	167	171	146	72	53	47
Spreading of tips	42.4	636	199	114	121	31	2	1
Bruise damage	23.6	843	188	52	19	1	0	1
New growth	12.1	970	55	42	20	10	4	3
Freeze damage	9.8	996	9	11	22	17	15	34
Unidentified decays	9.5	999	102	0	2	0	0	1
Grade defects <sup>b</sup>	9.5	999	70	34	0	0	0	1
Shriveling	6.2	1,036	22	15	16	6	7	2
Phytophthora rot	3.6	1,064	12	10	9	6	3	0
Gray mold rot	3.3	1,068	10	10	4	3	5	4
Soft/flaccid spears	1.4	1,089	4	1	3	4	1	2
Watery soft rot	0.7	1,096	2	3	2	0	1	0
Sunken discoloration	0.6	1,097	2	2	1	1	1	0
Scarring	0.5	1,099	4	1	0	0	0	0
Insect damage	0.4	1,100	4	0	0	0	0	0
Misshapen spears	0.4	1,100	3	1	0	0	0	0
Fusarium rot	0.3	1,101	1	0	1	0	0	1
Miscellaneous <sup>c</sup>	0.3	1,101	0	1	0	0	2	0

<sup>a</sup>From six states and six foreign countries.<sup>b</sup>Mechanical damage, poorly trimmed, characteristic color lacking, or unidentified defects.<sup>c</sup>Rhizopus rot, blue mold rot, and brown discoloration.**Table 4.** Disorders reported in USDA inspections of asparagus shipments on the New York market from main sources of supply, 1972–1985

Source	Shipments (no.)	Disorders and percentages of shipments affected								
		Bacterial soft rot	Spreading of tips	Bruise damage	Unidentified decays	Shriveling	Gray mold rot	Freeze damage	Phytophthora rot	Other rots
California	745	50.7	47.4	28.9	10.9	4.3	2.7	12.3	3.6	1.2 <sup>a</sup>
Mexico	149	85.2	30.9	14.8	4.0	9.4	6.0	4.7	4.0	1.3 <sup>b</sup>
Chile	108	79.6	23.1	10.2	9.3	6.5	2.8	0.9	2.8	0
Washington	60	46.7	56.7	8.3	11.7	25.0	3.3	11.7	5.0	0

<sup>a</sup>Rhizopus, Fusarium, and watery soft rots.<sup>b</sup>Fusarium and watery soft rots.

**Table 5.** Frequency of disorders reported in USDA inspections of 1,455 eggplant shipments<sup>a</sup> on the New York market, 1972–1985

Disorder	Shipments affected (%)	Number of shipments affected according to incidence class (% fruit)						
		0	1–5	6–10	11–20	21–33	34–50	>50
Fruit rot	70.5	429	285	374	247	70	30	20
Brown discoloration (scald)	27.1	1,061	129	119	111	26	9	0
Bacterial soft rot	21.9	1,136	95	92	79	33	12	8
Sunken discoloration	18.2	1,190	96	103	55	7	2	2
Bruise damage	13.1	1,265	67	71	44	8	0	0
Shriveling	12.5	1,273	59	51	49	17	6	0
Scars, cuts/punctures	6.8	1,356	49	38	7	5	0	0
Unidentified decays	5.1	1,381	70	3	0	0	1	0
Soft fruit	5.1	1,381	19	25	20	9	1	0
Alternaria rot	3.9	1,398	17	23	15	1	1	0
Sunken areas	3.8	1,400	14	24	14	1	1	1
Gray mold rot	1.2	1,437	8	3	5	2	0	0
Pitting	1.2	1,438	7	4	6	0	0	0
Chilling damage	1.0	1,441	1	0	5	2	4	2
Insect damage	0.9	1,442	9	4	0	0	0	0
Misshapen fruit	0.8	1,443	9	3	0	0	0	0
Freeze damage	0.5	1,448	3	0	2	1	0	1
Rhizopus rot	0.3	1,450	0	3	2	0	0	0
Internal discoloration	0.2	1,452	3	0	0	0	0	0
Phytophthora rot	0.1	1,453	0	1	1	0	0	0
Miscellaneous <sup>b</sup>	0.2	1,452	3	0	0	0	0	0

<sup>a</sup>From 12 states, Puerto Rico, and four foreign countries.<sup>b</sup>Fusarium rot, stem-end rot, and sunscald.**Table 6.** Disorders reported in USDA inspections of eggplant shipments on the New York market from main sources of supply, 1972–1985

Source	Shipments (no.)	Disorders and percentages of shipments affected								
		Fruit rot	Bacterial soft rot	Brown discoloration	Sunken discoloration	Bruise damage	Shriveling	Unidentified decays	Alternaria rot	Other rots
Mexico	923	71.8	25.6	29.6	19.4	12.9	11.2	5.1	2.8	2.1 <sup>a</sup>
Florida	391	70.8	14.3	20.7	17.1	12.8	11.8	4.3	4.1	1.0 <sup>b</sup>

<sup>a</sup>Gray mold, Rhizopus, and Phytophthora rots.<sup>b</sup>Gray mold, Rhizopus, stem-end, and Fusarium rots.**Table 7.** Frequency of disorders reported in USDA inspections of 1,295 snap bean shipments<sup>a</sup> on the New York market, 1972–1985

Disorder	Shipments affected (%)	Number of shipments affected according to incidence class (% pods)						
		0	1–5	6–10	11–20	21–33	34–50	>50
Russetting	47.0	686	170	173	178	52	12	24
Gray mold rot	38.6	795	211	160	88	19	7	15
Cottony leak	18.2	1,059	75	82	48	20	4	7
Unidentified decays	14.7	1,104	187	1	2	0	0	1
Brown discoloration	13.2	1,124	43	52	51	16	9	0
Bacterial soft rot	13.1	1,125	98	39	18	8	4	3
Grade defects <sup>b</sup>	12.5	1,133	56	63	31	9	3	0
Watery soft rot	7.6	1,196	46	31	17	4	1	0
Shriveling	4.7	1,234	25	10	12	6	3	5
Rhizopus rot	3.8	1,246	17	15	12	2	2	1
Anthraco-nose	2.5	1,262	20	6	6	1	0	0
Freeze damage	2.1	1,268	3	0	4	7	4	9
Sunscald	1.9	1,270	18	7	0	0	0	0
Bruise damage	0.9	1,283	7	4	0	0	0	1
Insect damage	0.6	1,287	7	1	0	0	0	0
Pitting	0.5	1,288	4	0	2	1	0	0
Soft/flaccid pods	0.4	1,290	4	0	0	1	0	0
Rust	0.3	1,291	1	1	2	0	0	0
Soil rot	0.2	1,293	0	1	1	0	0	0
Alternaria rot	0.2	1,293	1	0	0	1	0	0
Misshapen pods	0.2	1,293	2	0	0	0	0	0

<sup>a</sup>From 13 states, Puerto Rico, and five foreign countries.<sup>b</sup>Principally mechanical damage and scarring.

**Table 8.** Frequency of disorders reported in USDA inspections of 838 Florida snap bean shipments on the New York market, 1972–1985

Disorder	Shipments affected (%)	Number of shipments affected according to incidence class (% pods)						
		0	1–5	6–10	11–20	21–33	34–50	>50
Russetting	44.2	468	113	98	107	27	4	21
Gray mold rot	37.0	528	145	101	49	8	3	4
Cottony leak	17.3	693	53	50	27	9	2	4
Unidentified decays	15.8	706	131	0	1	0	0	0
Bacterial soft rot	13.2	727	70	22	11	5	1	2
Grade defects	12.6	732	26	48	25	5	2	0
Brown discoloration	10.7	748	24	27	26	9	4	0
Watery soft rot	8.4	768	31	23	14	2	0	0
Shriveling	4.2	803	19	5	6	2	1	2
Rhizopus rot	3.8	806	10	9	11	2	0	0
Anthracnose	3.1	812	15	6	4	1	0	0
Freeze damage	2.0	821	3	0	3	6	1	4
Sunscald	1.7	824	8	6	0	0	0	0
Bruise damage	1.2	828	6	3	0	0	0	1
Soft/flaccid pods	0.6	833	4	0	0	1	0	0
Insect damage	0.5	834	3	1	0	0	0	0
Rust	0.2	836	1	1	0	0	0	0
Soil rot	0.2	836	0	1	1	0	0	0
Misshapen pods	0.1	837	1	0	0	0	0	0

**Table 9.** Frequency of disorders reported in USDA inspections of 242 Mexico snap bean shipments on the New York market, 1972–1985

Disorder	Shipments affected (%)	Number of shipments affected according to incidence class (% pods)						
		0	1–5	6–10	11–20	21–33	34–50	>50
Russetting	58.7	100	27	48	51	11	3	2
Gray mold rot	42.6	139	37	38	21	4	2	1
Brown discoloration	24.4	183	14	18	18	7	2	0
Cottony leak	20.7	192	17	13	12	7	0	1
Grade defects	12.8	211	21	7	2	0	1	0
Bacterial soft rot	12.4	212	16	7	5	2	0	0
Unidentified decays	10.7	216	25	1	0	0	0	0
Watery soft rot	6.6	226	7	6	2	1	0	0
Rhizopus rot	3.7	233	4	4	1	0	0	0
Sunscald	2.1	237	4	1	0	0	0	0
Shriveling	2.1	237	0	3	2	0	0	0
Alternaria rot	0.8	240	1	0	0	1	0	0
Bruise damage	0.8	240	2	0	0	0	0	0
Freeze damage	0.8	240	0	0	0	0	1	1
Rust	0.8	240	0	0	2	0	0	0

respectively. Isolated occurrences were also noted of *Rhizopus* rot (*R. stolonifer*), *Phytophthora* rot (*Phytophthora* sp.), *Fusarium* rot (*Fusarium* sp.), and stem-end rot (*Diplodia natalensis*).

Brown discoloration (scald) (27.1%) and sunken discoloration (18.2%) were the most damaging nonparasitic disorders. The symptoms described for these two disorders are commonly associated with chilling injury, identified separately in 1% of the shipments. Eggplants are susceptible to injury when held for some time below 7 C. Disorders described as sunken areas (3.8%) and pitting (1.2%) could also have been expressions of chilling injury. Bruise damage (13.1%) and shriveling (12.5%) seriously damaged some shipments. Other noteworthy disorders of eggplant were scars and cuts/punctures resulting from mechanical injuries and soft fruit. The few remaining nonparasitic disorders were each reported in less than 1% of the inspections (Table 5).

Important disorders reported in inspections of eggplant shipments from Mexico and Florida are shown in Table 6. Frequency of occurrences for disorders listed were very similar in Mexican and Florida fruit except for bacterial soft rot and brown discoloration (scald).

**Snap beans.** USDA personnel inspected 1,295 snap bean shipments whose contents represented 2.0% of the volume delivered to the New York market during 1972–1985 (Table 2). Ten parasitic diseases (1,286 occurrences), six physiological disorders (855 occurrences), and five types of injury (234 occurrences) were reported (Table 7). Gray mold rot (*B. cinerea*), russetting of the pod, and grade defects (principally mechanical damage and scarring) were the most frequently reported parasitic disease, physiological disorder, and injury, respectively.

Gray mold rot was the most damaging parasitic disease, reported in 38.6% of the inspections; more than 10% of the contents were rotted in a substantial number of shipments (Table 7). Cottony leak (*Pythium butleri*) was reported in 18.2% of the inspections and seriously damaged many shipments. Bacterial soft rot (*Erwinia carotovora*) and watery soft rot (*S. sclerotiorum*) occurred less frequently but also caused serious damage. *Rhizopus* rot (*R. stolonifer*) and anthracnose (*Colletotrichum lindemuthianum*) were other diseases of importance, affecting 3.8 and 2.5% of the shipments, respectively. Diseases reported infrequently were rust (*Uromyces phaseoli*), soil rot (*Rhizoctonia solani*), and

*Alternaria* rot (*Alternaria* sp.). Unidentified decays were reported in 14.7% of the inspections but nearly all were in the lowest incidence class.

Russetting, a form of chilling injury, was reported in 47% of the shipments inspected, more often than any other disorder (Table 7). The rusty brown necrosis of the surface cells results principally from holding the pods below 5 C, and the condition worsens when the pods are wet (16,17). Incidences of russetting were high in a significant number of shipments. Brown discoloration, which could be another description for russetting or chilling injury, was noted in 13.2% of the shipments. Grade defects, chiefly minor degrees of mechanical injury and scarring, followed in order of occurrence. Shriveling was the most serious of a number of other nonparasitic disorders, including freeze damage and sunscald.

Tables 8 and 9 show the frequency of disorders observed in snap bean shipments from Florida and Mexico, respectively. The same seven disorders were reported in 10% or more of the shipments from both sources, with russetting and gray mold rot ranking first and second. Little if any difference was observed among the other five disorders, except for brown discoloration. Of the disorders reported in less than 10% of the inspections, watery soft rot and *Rhizopus* rot were the most damaging. Shriveling was considerably more severe in the Florida shipments. Of some note were the reports of anthracnose and soil rot in Florida shipments only and of *Alternaria* rot in Mexico shipments only. Differences among the remaining disorders from both sources were negligible.

**Summary.** We do not claim that the information presented in this report represents the arrival condition of asparagus, eggplant, and snap beans on the New York market during the period covered. Most inspections were conducted on shipments that arrived "distressed" or with questionable quality. Nonetheless, the inspection of more than 6,500 crates of asparagus, 8,500 packs of eggplant, and 7,500 containers of snap beans should provide a fairly accurate appraisal of the disorders causing considerable spoilage in the marketing of these commodities (6). Although the identity or etiology of some disorders may be questioned or unresolved, the number of occurrences of the disorders should be accepted as reasonably accurate.

The high incidence of fruit rot in eggplant shipments reflects on the inadequacy of disease control measures in the field. The extent of bacterial soft rot, mechanical damage, and disorders associated with chilling injury in asparagus, eggplant, and snap beans indicates handling and protective services accorded these crops after harvest and during transit were inadequate or remiss. Hopefully, the information in this report will be used to resolve some of these problems and subsequently reduce losses currently sustained in the marketing of these vegetables.

#### ACKNOWLEDGMENT

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This section is designed to help APS members understand more about APS Sustaining Associates. Information was supplied by company representatives. Each month different companies will be featured. A complete listing appears in each issue of *Phytopathology*.

**Funk Seeds International, Contact: Loral Castor, Research Department, P.O. Box 2911, Bloomington, IL 61702; 309/829-9461.** Funk Seeds International, a wholly-owned subsidiary of CIBA-GEIGY Corp., is one of the nation's leading marketers of agricultural seeds, including hybrid corn and grain sorghum, and soybean and forage varieties, since 1901. Funk seeds is marketed directly or through associate companies in the United States and internationally as part of the worldwide CIBA-GEIGY seeds network. Funk Seeds International operates 24 research stations in 16 states. Plant pathologists support the activities of plant breeders and numerous personnel in the production and marketing areas of the company. Pathology research emphasis is on the identification and evaluation of genetic resistance. Disease resistance is an increasingly important component of the high-yielding hybrids and varieties that Funk Seeds offers to U.S. farmers.

**Great Lakes Chemical Corporation, Contact: David A. Rickard, Ph.D., Manager, Agricultural Chemicals Development-Phytopathology, P.O. Box 2200, W. Lafayette, IN 47906; 317/497-6354.** An international diversified specialty chemical company with key products in many fields, Great Lakes' expertise ranges from biotechnology to lubrication, flame retardants to drilling fluids, water sanitizers to toxicology testing services, and chemical intermediates for agri-chemicals to electronic circuitry. Already the world leader in production of bromine chemicals, including the versatile agricultural fumigant, methyl bromide, Great Lakes has become the leading maker of furfural and furfural-based specialty chemicals

derived from agricultural waste materials and used in a wide range of products from plastics to agricultural spray adjuvants. Each year an extensive effort is made to expand the uses for its standard—setting agricultural chemicals through grant-supported research and to discover better products to both produce and protect our food and fiber.

**Griffin Corporation, Contact: Donnell W. Guy, Jr., P.O. Box 1847, Valdosta, GA 31603-1847; 912/242-8635.** Griffin Corp. has been serving agriculture since 1935, beginning as a seed retail store and progressing into one of the foremost agricultural chemical manufacturers in the United States today. Headquartered in Valdosta, GA, Griffin has three operating companies with research, manufacturing, sales, and marketing functions in Valdosta, Houston, TX, and Casa Grande, AZ. Griffin manufactures and markets their own brands of high quality fungicides, insecticides, and herbicides, which are used for a wide variety of crops in virtually every major U.S. agricultural market and more than 50 foreign countries. All Griffin products are marketed by Griffin Ag Products Co., Inc., in the United States and by Griffin International Corporation outside the United States.

**Gustafson, Inc., Contact: Ray Knake, Northern Regional Manager, 3124 E. Ct. Ave., Des Moines, IA 50317; 515/266-3221.** Gustafson was formed over 50 years ago as a supplier of seed treatment chemicals and equipment. The company has grown to become the largest supplier of seed treatment materials in the United States. Chemicals currently marketed include protective and systemic fungicides and insecticides. We are currently pioneering the use of biologicals as growth promotants. Our major effort at this time is in the area of systemic fungicides for control of *Phytophthora* rot rot, powdery and downy mildew control, leaf rust control, and suppression of take-all. Our company annually supports plant pathologists across the United States in an effort to increase the diseases controlled by seed treatment.

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