

Disorders in Celery and Carrot Shipments to the New York Market, 1972-1985

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

Celery (*Apium graveolens* L. var. *dulce* (Mill.) Pers.) and carrots (*Daucus carota* L.) rank among the 10 most important vegetable crops consumed in metropolitan New York. California supplies about 73% of both vegetables to the New York City market. Florida is next in importance, supplying about 19% of the celery and 8% of the carrots. Other important suppliers are Canada, with about 12% of the carrots; Michigan and Texas, with about 2% of each commodity; and New York, with about 4% of the celery (13,14).

Receivers and shippers who question the grade and quality standards of fresh produce on arrival often request (and pay for) inspections of such shipments by the U.S. Department of Agriculture. The certificates on which the inspectors record their observations have been made available to us. This report, a continuation of a series (1-11), was prepared from a computerized data base abstracted from USDA certificates on the arrival condition of celery and carrots at the New York City market during 1972-1985. Approximately 756,092 t of celery (52% by rail and 48% by truck) and about 596,783 t of carrots (72% by rail and 28% by truck) were delivered to the New York market during that 14-year period (Table 1) (13,14).

Celery. USDA personnel named or described nine parasitic diseases, 13 physiological disorders, and six types of injuries in the inspections of 5,050 celery shipments from 11 states and three countries (Tables 2 and 3). These shipments contained 79,500 t, or about 10% of the total delivered (13,14). Bacterial soft rot (*Erwinia* sp.) accounted for almost half of the 6,333 occurrences of disorders. Bruise damage and black heart were the nonparasitic disorders noted most often.

The vast majority of celery inspections were conducted on California shipments (Table 4). Bacterial soft rot was reported in 61.4% of inspected shipments, and damage was serious in most. Less than 20% of the affected shipments had 1-5% rot (lowest incidence), whereas 41%, or 1,057 shipments, had more than 10% rot (76 shipments had more than 50% rot, the highest incidence). Watery soft rot (*Sclerotinia sclerotiorum*) was another severely damaging disease, occurring in 12.3% of shipments; over 40%, or 213 shipments, had more than 10% rot. Another important market disease was gray mold rot (*Botrytis cinerea*), reported in 3.5% of the shipments and distributed throughout the incidence classes. Unidentified decays occurred in 10.4% of the shipments but were less damaging and confined mostly to the lowest incidence class. Late blight (*Septoria apiicola*), a common field disease, was reported in only 1.2% of shipments but was distributed throughout all incidence classes. Other diseases, e.g., crater spot (*Rhizoctonia solani*) and brown spot (*Cephalosporium apii*), were noted relatively infrequently.

Among the nonparasitic disorders, bruise damage was noted most often (17%) but black heart and freeze damage were more destructive (Table 4). Black heart (a field disease induced by a lack of calcium [12]) and, especially, freeze damage were distributed in the higher incidence classes. Other disorders of note were pithiness, external discoloration, brown discoloration, and cracked stem due to boron deficiency.

In Florida celery shipments, bacterial soft rot (54.9%) was the

most destructive disorder noted frequently in the high incidence classes (Table 5). Watery soft rot (8.9%) was also distributed throughout all incidence classes. Disorders reported in California shipments but not in Florida shipments were crater spot (0.6%), brown stem (0.1%), brown spot (0.1%), and

Table 1. Volume of celery and carrots shipped to the New York market, 1972-1985

Year	Number of 45,400-kg units			
	Celery		Carrots	
	Rail	Truck	Rail	Truck
1972	1,334	320	810	108
1973	1,187	393	928	86
1974	1,251	337	902	95
1975	885	439	947	93
1976	522	511	758	168
1977	476	507	651	226
1978	135	677	493	171
1979	291	643	502	319
1980	251	777	652	247
1981	397	853	521	427
1982	507	770	598	435
1983	476	748	615	442
1984	382	525	525	440
1985	578	482	523	463
Total	8,672	7,982	9,425	3,720

Table 2. Celery and carrot shipments inspected by the USDA on the New York market, 1972-1985

Year	Celery		Carrots	
	Shipments (no.)	Packs ^a (no.)	Shipments (no.)	Packs ^b (no.)
1972	1,049	484,314	528	359,164
1973	486	252,835	266	161,961
1974	402	212,475	134	101,426
1975	232	120,263	116	99,561
1976	302	190,500	80	65,948
1977	380	304,696	231	225,632
1978	213	157,343	133	126,509
1979	113	68,261	135	106,368
1980	160	99,794	116	95,003
1981	193	120,653	28	28,471
1982	273	174,483	156	115,167
1983	428	253,511	202	185,730
1984	502	274,590	167	119,340
1985	317	202,794	133	125,684
Total	5,050	2,916,512	2,425	1,915,964

^aCartons or crates with 27.24 kg of celery.

^bMostly sacks with 21.79 kg of carrots.

Table 3. Disorders reported in USDA inspections of 5,050 celery shipments on the New York market, 1972–1985

Parasitic diseases	Shipments (no.)	Physiological disorders	Shipments (no.)	Injuries	Shipments (no.)
Bacterial soft rot	3,051	Black heart	191	Bruise damage	805
Watery soft rot	597	External discoloration	85	Grade defects ^a	280
Unidentified decays	543	Yellowing	41	Scuffing	158
Gray mold rot	164	Pithiness (hollow stem)	37	Freeze damage	137
Late blight	59	Brown discoloration	15	Insect damage	77
Crater spot	27	Seed stems	15	Sunscald	3
Early blight	8	Growth cracks	11		
Brown spot	4	Cracked stem	10		
Bacterial blight	2	Brown stem	5		
		Pitting	2		
		Misshapen stalks	2		
		Brown leaves	2		
		Wilting	2		

^a Chiefly minor mechanical damage, poorly formed or spreading stalks, scarring, dirt, and snail damage.

Table 4. Frequency of common disorders reported in USDA inspections of 4,177 California celery shipments on the New York market, 1972–1985

Disorder	Shipments affected (%)	Number of shipments affected according to incidence class (%)						
		0	1–5	6–10	11–20	21–33	34–50	>50
Bacterial soft rot	61.4	1,613	452	1,055	674	204	103	76
Bruise damage	17.0	3,467	443	224	40	3	0	0
Watery soft rot	12.3	3,664	139	161	116	51	32	14
Unidentified decays	10.4	3,743	415	5	11	1	0	2
Black heart	3.8	4,020	69	38	32	14	2	2
Gray mold rot	3.5	4,030	10	44	75	15	2	1
Freeze damage	2.8	4,062	6	10	27	16	24	32
External discoloration	1.3	4,121	22	23	6	4	1	0
Late blight	1.2	4,128	8	19	15	3	2	2
Pithiness (hollow stem)	0.6	4,150	7	13	4	2	1	0
Crater spot	0.6	4,153	14	8	1	0	0	1
Brown discoloration	0.3	4,165	8	4	0	0	0	0
Cracked stem	0.2	4,170	6	1	0	0	0	0
Brown stem	0.1	4,173	2	1	1	0	0	0
Brown spot	0.1	4,174	0	2	1	0	0	0
Bacterial blight	<0.1	4,175	0	0	1	0	0	1
Early blight	<0.1	4,176	0	1	0	0	0	0

Table 5. Frequency of common disorders reported in USDA inspections of 719 Florida celery shipments on the New York market, 1972–1985

Disorder	Shipments affected (%)	Number of shipments affected according to incidence class (%)						
		0	1–5	6–10	11–20	21–33	34–50	>50
Bacterial soft rot	54.9	324	81	136	98	34	22	24
Unidentified decays	13.5	622	94	1	1	1	0	0
Bruise damage	11.0	640	45	27	6	1	0	0
Watery soft rot	8.9	655	22	17	18	5	1	1
Black heart	4.5	687	16	9	4	2	1	0
External discoloration	3.6	693	5	10	6	4	1	0
Freeze damage	2.2	703	0	3	7	2	1	3
Gray mold rot	1.3	710	0	2	5	2	0	0
Early blight	1.0	712	0	1	3	2	0	1
Pithiness (hollow stem)	0.8	713	0	1	4	1	0	0
Late blight	0.4	716	2	0	1	0	0	0
Sunscald	0.4	716	0	0	2	1	0	0
Cracked stem	0.4	716	3	0	0	0	0	0

Table 6. Disorders reported in USDA inspections of 2,323 topped and 102 bunched carrot shipments on the New York market, 1972–1985

Parasitic diseases	Shipments		Shipments		Shipments (no.)
	(no.)	Physiological disorders	(no.)	Injuries	
Bacterial soft rot	802	New top growth	184	Broken/cracked roots	730
Leaf stem decay	182	Brown/black discoloration	74	Freeze damage	28
Watery soft rot	133	Misshapen roots	7	Bruise damage	5
Soft/slimy rot	86	Shriveling	5	Insect damage	5
Sour rot	82	Yellowing	4	Broken tips	4
Unidentified decays	70	Growth cracks	4	Sunburn	2
Gray mold rot	36	Soft roots	2		
Black rot	21	Secondary rootlet growth	2		
Rhizopus rot	8	Sunken areas	1		
Black mold	7				
Blue mold rot	2				

Table 7. Principal disorders reported in USDA inspections of topped carrot shipments on the New York market, 1972–1985

Source Pack	Number of shipments	Disorders and percentages of shipments affected									
		Bacterial soft rot	Broken/cracked roots	Watery soft rot	Leaf stem decay	New top growth	Sour rot	Soft/slimy rot	Unidentified decays	Gray mold rot	Brown/black discoloration
California											
Prepackaged	1,128	30.2	29.5	6.2	7.5	8.6	3.1	2.3	2.2	1.8	1.7
Loose	366	29.0	33.6	3.0	8.5	11.5	1.6	0.6	4.1	0.8	1.4
Canada											
Prepackaged	156	46.2	34.0	4.5	11.5	1.9	5.1	10.9	2.6	0.7	8.3
Loose	42	40.5	52.4	4.8	7.2	2.4	2.4	2.4	2.4	...	7.2
Texas											
Prepackaged	122	45.1	16.4	10.7	8.2	2.5	6.6	0.8	2.5	...	...
Loose	60	46.7	20.0	10.0	5.0	6.7	3.3	...	1.7	8.3	1.7
Florida											
Prepackaged	62	25.8	46.8	6.5	...	4.8	...	...	1.6	...	...
Loose	20	20.0	45.0	5.0	...	...	...	...	...	...	5.0

Table 8. Frequency of disorders reported in USDA inspections of 1,128 prepackaged California carrot shipments on the New York market, 1972–1985

Disorder	Shipments affected (%)	Number of shipments affected according to incidence class (% roots)						
		0	1–5	6–10	11–20	21–33	34–50	> 50
Bacterial soft rot	30.2	787	157	91	56	22	7	8
Broken/cracked roots	29.5	795	245	68	19	1	0	0
New top growth	8.6	1,031	37	34	16	7	2	1
Leaf stem decay	7.5	1,043	43	29	11	2	0	0
Watery soft rot	6.2	1,058	25	17	16	9	3	0
Sour rot	3.1	1,093	10	13	4	3	4	1
Soft/slimy rot	2.3	1,102	12	4	2	3	1	4
Unidentified decays	2.2	1,103	19	2	2	0	0	2
Gray mold rot	1.8	1,108	4	6	5	5	0	0
Freeze damage	1.7	1,109	0	1	9	4	1	4
Brown/black discoloration	1.7	1,109	8	9	1	1	0	0
Black rot	0.5	1,122	2	2	1	0	1	0
Rhizopus rot	0.3	1,125	0	3	0	0	0	0
Black mold	0.3	1,125	2	1	0	0	0	0
Miscellaneous ^a	0.5	1,122	3	0	1	0	1	1

^a Blue mold rot, bruise damage, insect damage, sunburn, shriveling, and secondary rootlet growth.

bacterial blight (<0.1%). Sunscald (0.4%) was reported in Florida shipments but not in California shipments.

Carrots. During 1972–1985, USDA personnel inspected 2,425 carrot shipments (Table 2) from 11 states, Canada, and Mexico. These shipments contained 41,772 t, or about 7% of the carrots delivered to the New York City market (13,14). Eleven

parasitic diseases, nine physiological disorders, and six kinds of injuries in topped (2,323 shipments) or bunched (102 shipments) carrots were described (Table 6). Parasitic diseases comprised 58% of all the disorder occurrences, with bacterial soft rot accounting for more than one-half. The dominant injury reported was broken/cracked roots. The leading

Table 9. Frequency of disorders reported in USDA inspections of 366 loose-packed, topped California carrot shipments on the New York market, 1972–1985

Disorder	Shipments affected (%)	Number of shipments affected according to incidence class (% roots)						
		0	1–5	6–10	11–20	21–33	34–50	> 50
Broken/cracked roots	33.6	243	93	22	8	0	0	0
Bacterial soft rot	29.0	260	57	23	18	3	2	3
New top growth	11.5	324	11	14	11	6	0	0
Leaf stem decay	8.5	335	10	13	5	3	0	0
Unidentified decays	4.1	351	12	2	1	0	0	0
Watery soft rot	3.0	355	6	4	1	0	0	0
Sour rot	1.6	360	2	3	1	0	0	0
Brown/black discoloration	1.4	361	1	1	2	1	0	0
Gray mold rot	0.8	363	2	1	0	0	0	0
Soft/slimy rot	0.6	364	1	1	0	0	0	0
Miscellaneous ^a	1.4	361	3	1	0	1	0	0

^aSoft, shriveled, or misshapen roots and freeze or bruise damage.

physiological disorder overall was new top growth, but brown/black discoloration was most common in the small number of bunched carrot shipments.

Most of the inspected topped carrot shipments were from California (Table 7); Canada and Texas were the other major sources. Regardless of source or packaging, the two major problems identified were bacterial soft rot and broken/cracked roots. No significant differences were apparent in disorder occurrences between prepackaged (454-g consumer packs) and loose (21.8 kg per bag) carrots.

The occurrences of bacterial soft rot in prepackaged California carrot shipments exceeded those of all other rots and decays (Table 8). Leaf stem decay (decay of new top growth) and watery soft rot were next in occurrences. Other diseases of note were sour rot (*Geotrichum candidum*), gray mold rot, soft/slimy rot, and unidentified decays. Black rot (*Stemphylium radicinum*), Rhizopus rot (*R. stolonifer*), and black mold (*Thielaviopsis basicola*) occurred infrequently. Four disorders—bacterial soft rot, new top growth, sour rot, and soft/slimy rot—were reported in all incidence classes. Relatively few shipments (1.7%) were affected by freeze damage or brown/black discoloration. No essential differences in occurrences or magnitude of disorders were apparent between prepackaged carrots and loose-packed, topped carrots (Table 9) shipped from California.

Summary. The information presented here is not representative of the arrival condition of all celery and carrots delivered to the New York City market. Most inspections were conducted on shipments that were “distressed” or of questionable quality. However, trained USDA inspectors routinely examined six or more packs per shipment, and over the 14-year period more than 30,000 packs of celery and 14,000 packs of carrots were examined. The cause of some diseases reported in these examinations may be questioned, but certainly not their occurrences or those of other disorders. The findings reported in these inspections should provide an accurate appraisal of the diseases and disorders occurring in the marketing of celery and carrots. This information should be useful in establishing programs to reduce losses and maintain produce quality.

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.

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