CHILLING INJURY OF EGGPLANT FRUITS

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CHILLING INJURY OF EGGPLANT FRUITS

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SUMMARY

Low, but nonfreezing temperatures seriously affected the quality of eggplant fruits. Injury, not apparent at low temperature, developed rapidly when the fruits were held at 70° F.

Injury was manifested as dead and moldy calyxes, scald, flesh browning, pitting following sand scars, and numerous lesions of alternaria rot.

Fruits developed some injury after 6 days at 32° and 40° F., and the injury increased sharply as the holding period was increased. Eggplant fruits held for 6 days under top ice developed serious injury.

The recommended temperature for transit or storage is 45° to 50° F. Eggplants can be held at this temperature for 6 or 7 days.

THE PROBLEM

Eggplant fruits are subject to chilling injury if held at low, but nonfreezing temperatures for about a week or longer.

The problem as observed in the commercial handling of the fruits is confined to eggplants overrefrigerated during a 6- to 8-day transit period or held at 40° F. for several days after arriving at the terminal market. Chilling injury has been observed also on eggplant fruits shipped in mixed loads of produce under top ice.

These tests were conducted to determine the effect of low, but nonfreezing temperatures on chilling injury, to identify and describe the symptoms, and to study the relationship of chilling injury to alternaria rot.

SOURCE OF EGGPLANT FRUITS USED IN TESTS

Eggplants of the Black Beauty variety were grown at Beltsville, Md., for the 1962 and 1963 tests. The fruits were washed and wiped dry. Defective and poorly shaped fruits were discarded. The fruits were placed under test the day after harvest.

In 1964, good-quality New Jersey-grown fruits of an unidentified variety were purchased on the local wholesale market. These were placed under test the same day as purchased.

RESPONSE TO HOLDING TEMPERATURES

In earlier tests eggplant fruits were held at 50°, 45°, 40°, and 32° F. for 4, 6, and 10 days. In some of the later tests the 4-day holding period was omitted. Five tests were made. During each of two seasons one of the lots held in a 45° room was under top ice for 4 and 6 days. The containers of eggplant fruits to be under top ice were stacked two high in a box and the sides and top were covered with crushed ice. The ice was replenished every other day to keep the commodity covered. The temperature of the ice was about 32°. The commodity temperature during holding under top ice is given in table 1.

Data were obtained on the condition of the calyxes, physiological symptoms of chilling injury such as scald and flesh browning, and the kind and extent of decay. Data were obtained as the test lots were

TABLE 1.—*Temperature of eggplant fruits during 6 days under top ice*

Specified periods	Immediately below skin	Center of flesh
	° *F.*	° *F.*
At start	66. 5	67. 5
Average after 10 hours	39. 6	39. 5
Highest after 10 hours	42. 4	43. 0
Lowest after 10 hours	32. 5	32. 5
6-day average after 10 hours	36. 6	36. 4
6-day average from start	39. 3	39. 4

removed from the holding temperatures and again after 3 days at 70° F.

Low temperatures injured eggplant fruits in proportion to the length of the holding period. The injury was not evident while the fruits were at low temperature, but developed in a day or two after they were moved to 70° F. Considerable pitting developed after 4 days at 32° and on fruits under top ice, but other symptoms of chilling injury were very slight (table 2). A considerable number of fruits held for 6 days at 32° and 40° and those under top ice developed chilling injury. Only slight or very slight injury developed after 6 days at 45°. Those held for 10 days at 32° and 40° were seriously affected. Moderate injury developed in fruits held at 45° for 10 days.

No chilling injury developed in eggplants held at 50° F. for 10 days or less. Since fruits held at 45° for 6 days escaped chilling injury, this temperature served as a minimum in a recommended transit or storage temperature range of 45° to 50° for a 6- or 7-day period. This much refrigeration is needed to retard aging and certain kinds of decay.

Dying and discoloration of the calyxes or stem cap are the first signs of deterioration of eggplant fruits. Although this deterioration

TABLE 2.—*Effect of chilling and nonchilling temperatures, followed by 3 days at 70° F., on eggplant fruits*

Holding period and storage temperature (° F.)	Total fruits in test	Condition of calyxes			Symptoms of chilling injury			Decay	
		Over half of area green	Less than half of area green	Dead and moldy	Scald	Browning of flesh	Pitting following skin breaks	Numerous lesions of alternaria rot	Other rots
4 days:	*Number*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
50	81	68	32	0	0	0	5	0	1
45	81	59	41	0	0	0	4	0	0
45 [1]	49	16	84	0	2	4	69	4	0
40	81	42	58	0	1	0	6	0	0
32	80	26	74	0	1	4	23	1	1
6 days:									
50	93	41	49	10	0	0	8	2	1
45	93	38	51	11	5	0	8	3	0
45 [1]	48	0	31	69	50	10	29	25	6
40	93	11	70	19	20	10	8	11	0
32	92	0	66	34	35	40	15	15	2
10 days:									
50	92	28	68	4	0	0	8	3	7
45	92	15	75	10	18	24	12	15	3
40	92	7	57	36	51	57	19	50	2
32	94	0	8	92	91	77	32	73	1

[1] Under top ice.

was markedly increased by holding eggplants at 32° and 40° and at 45° F. under top ice (table 2), it was not considered a symptom of chilling injury, because the death of the calyxes is also an aging process. In addition to the calyxes dying, turning dark, or becoming decayed and moldy in the most seriously affected fruits, the stem cap also became detached after low-temperature holding.

SYMPTOMS OF LOW-TEMPERATURE INJURY

Scald, flesh browning, and to a less extent pitting following skin breaks such as sand scars were found to be symptoms of chilling injury on eggplant fruits.

Scald

Fruits with serious chilling injury developed scald, a physiological disorder, either in extensive or in restricted areas anywhere on the fruits. Some fruits developed only a few small spots whereas others developed numerous isolated spots (fig. 1). Affected areas had a cooked appearance and were medium brown. At first the scald areas were flush with the surface, but in a few days they became sunken.

FIGURE 1.—Eggplant fruit affected by scald when held at 32° for 10 days followed by 3 days at 70° F.

Browning of Flesh

Browning of flesh is symptomatic of physiological death of the affected tissues. The disorder is definitely associated with low-temperature injury, as it was much worse after 10 days at 32° and 40° F. than after 4 and 6 days at those or higher temperatures. In general, the area surrounding the placental tissues was more subject to browning than other tissues (fig. 2). In the most severely affected fruits practically all the tissues were a medium tannish brown.

Pitting

Commercially handled eggplant fruits often show a considerable number of skin breaks due to pressure against sharp particles of sand. Pitting following sand scars was notably increased by temperatures below 45° F. In the most severely affected fruits the pits were so numerous that the fruits appeared pebbly and unattractive. Pitting was greatly increased when top ice was used.

DECAY

Some fruits developed gray mold rot and rhizopus rot, but where decay was extensive it was due to *Alternaria tenuis* auct. As in other vegetables that are subject to chilling injury,[1] [2] [3] alternaria rot in-

[1] McCOLLOCH, L. P. ALTERNARIA ROT FOLLOWING CHILLING INJURY OF ACORN SQUASHES. U.S. Dept. Agr. Mktg. Res. Rpt. 518, 19 pp. 1962.

[2] McCOLLOCH, L. P. CHILLING INJURY AND ALTERNARIA ROT OF BELL PEPPERS. U.S. Dept. Agr. Mktg. Res. Rpt. 536, 16 pp. 1962.

[3] McCOLLOCH, L. P., and WORTHINGTON, J. T. LOW TEMPERATURE AS A FACTOR IN THE SUSCEPTIBILITY OF MATURE-GREEN TOMATOES TO ALTERNARIA ROT. Phytopathology 42: 425–427. 1952.

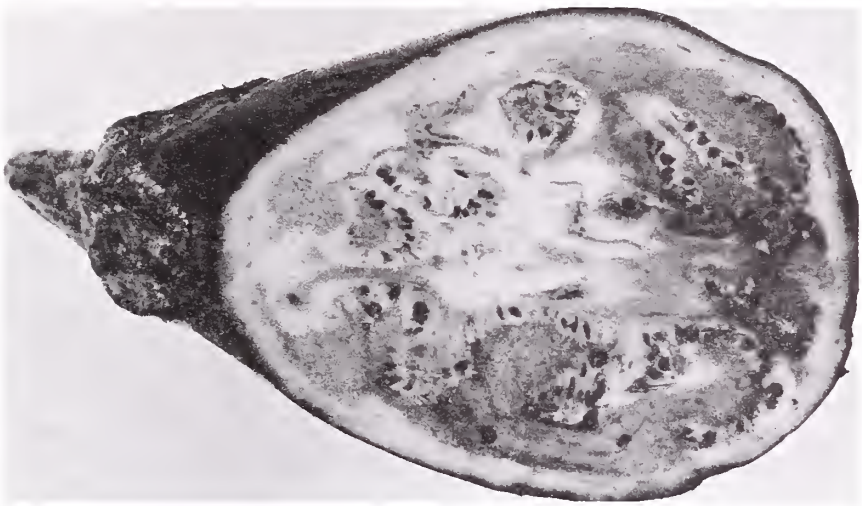

FIGURE 2.—Eggplant fruit seriously affected by browning of flesh when held at 32° for 10 days followed by 3 days at 70° F.

creased as the holding period at 32° and 40° F. was increased and thus served as a useful indicator of chilling injury.

When alternaria rot is first noticeable, the lesions are small, circular, and slightly sunken. As they develop, they tend to become somewhat elongated and irregular (fig. 3). Gradually some of the lesions may coalesce and penetrate the flesh one-half inch or more. They are at first medium brown, but gradually become blackish. The decayed flesh is spongy and tan to grayish tan. The surface of the lesions may be covered with loose, dark-gray hyphae. If conditions are favorable for sporulation, the surface of certain lesions may appear a velvety olive green because of the mass of spores and then it gradually blackens. Many of the lesions follow scald.

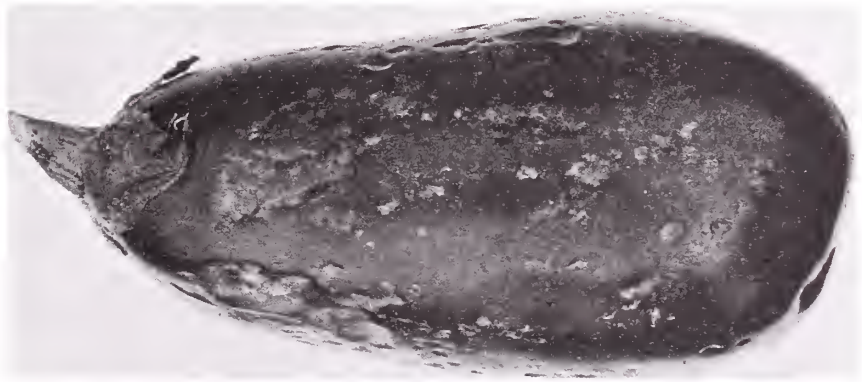

FIGURE 3.—Alternaria rot occurring as numerous lesions on eggplant fruit held at 32° for 10 days followed by 3 days at 70° F.

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