The Development of Chilling Injury in Three Types of Eggplants

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Summary
Commonly grown Western and Asian eggplants (large globe-shaped dark purple, cv. Black Bell; small elongated dark purple Japanese type, cv. Millionaire; and elongated light purple Chinese type, cv. unknown) all showed chilling injury symptoms when stored below the recommended temperature of 10°C (50°F). Internal discoloration and calyx discoloration were the symptoms observed first; pitting and discoloration of the fruit appeared later in storage at chilling temperatures. Chinese eggplants were somewhat more tolerant of chilling temperatures than Japanese eggplants which were slightly more tolerant than 'Black Bell' fruits. For 'Black Bell' eggplants, overall visual quality was best maintained at 10°C (50°F). At 7.5°C (45°F), chilling symptoms occurred after 12 days, at 5°C (41°F) chilling symptoms occurred at 6 days.

Introduction
To be of high quality, eggplants must have a shiny fruit surface with color typical of the variety, a fresh unblemished calyx, and be free of any decay, discoloration or other defects. The freshness of the calyx is a very important quality parameter and it is generally considered that calyx appearance declines more rapidly than does the quality of the fruit itself. Decay of the calyx has been successfully controlled with NAA and a fungicide (Temkin-Gorodeiski et al., 1993) and with a commercial hydrogen peroxide product (Fallik et al., 1994). Recommended storage temperatures for eggplants are 10°-12.5°C (50-55°F) (Hardenburg et al., 1986) but may vary depending on the variety (Monteiro Sigrist, 1981), maturity (Hardenburg et al., 1986) and the season (Hardenburg et al., 1986; Paull, 1990).

Because of their susceptibility to water loss, it is common that eggplants are stored at low temperatures to minimize the visible symptoms of weight loss. The low storage temperatures, however, induce chilling symptoms. Storage at too low temperatures and lack of rapid turnover result in chilling injury being a frequent problem during marketing and distribution of eggplants. Chilling symptoms include fruit and calyx discoloration, surface pitting, internal discoloration of the pulp and seeds, off-odor, and increased decay. Water loss and chilling symptoms were both reduced when eggplants were stored in polyethylene bags (Mohamed and Sealy, 1986; Fallik et al., 1995).

The objective of this study was to document the times and temperatures required to induce chilling injury in 3 types of eggplants widely produced in the San Joaquin Valley.

This data will be useful to better manage these products during postharvest handling and distribution.

Experimental

Product

A Western type (large globe-shaped dark purple, cv. Black Bell), Japanese type (small elongated dark purple, cv. Millionaire) and a Chinese type (elongated light purple, cv. unknown) eggplants were harvested on September 22 and October 18 from cooperating growers in the Fresno area and transported in bulk in carton boxes under ambient conditions to the Mann Laboratory where they were held overnight at 10°C.

Treatments

Two experiments were conducted. In the first experiment, fruits were placed on trays inside vented polyethylene bags and stored at 0°, 2.5°, 5°, 10° and 12.5°C (32°, 36°, 41°, 50° and 55°F). This maintained a very high humidity storage environment (>95% RH). Fruits were evaluated for quality parameters after 7, 14 and 21 days storage. The trays were removed from the bags and transferred to 20°C for 8 to 12 hours before evaluation. In the second experiment, fruits were placed on trays and overwrapped with a commercial food wrap to reduce water loss and stored on shelves at 2.5°, 5°, 7.5° and 10°C (36°, 41°, 45° and 50°F). The eggplants were evaluated after 3.5, 7, 10.5, 14 and 17.5 days storage. Eggplants were transferred (without removing the film overwrap) to 20°C for 8 to 12 hours before evaluation.

Evaluations

Overall visual quality was scored on a 9 to 1 scale, where 9=excellent, 7=good, 5=fair, 3=poor and 1=unuseable. Chilling injury was evaluated as the development of various specific symptoms including internal and external discoloration and pitting. These symptoms and decay were all scored on a scale of 1 to 5, where 1=none, 2=slight, 3=moderate, 4=moderately severe, and 5=severe. Initial and final weights were recorded for selected eggplants and % weight loss was calculated. Photographs were taken to illustrate the differences in quality of the eggplants after different periods of storage.

Statistical analysis

Data are the means from 5 to 8 fruits per evaluation per treatment. Significant differences among treatments were determined by ANOVA with calculation of LSD at the 5% level.

Results and Discussion

'Black Bell' is a large round dark purple eggplant with a large green calyx and weighed from 300-400 g. The Japanese eggplant is a small elongated very dark purple eggplant with a purple-green calyx and weighed from 80 to 120 g. The Chinese type is a large elongated eggplant, light to moderate purple in color with a green-purple calyx and weighed on average 100-160 g.

Results from the first experiment in which eggplants were stored at 0°, 2.5°, 5°, 10° and 12.5°C (32°, 36°, 41°, 50° and 55°F) for 7, 14 and 21 days are shown in **Tables 1, 2** and **3**. After 7 days, 'Black Bell' and Japanese eggplants stored at 0° and 2.5°C had "moderate" levels of chilling symptoms. The same eggplants stored at 5°C required 14 days to present a similar level of chilling injury. Fruits stored at 10° and 12.5°C did not present chilling symptoms for up to 21 days but did show high levels of decay, especially on the calyx. When decay was present on the calyx, discoloration scores also increased, although the discoloration was distinct from that induced by chilling temperatures. Chinese eggplants required longer to show the same degree of chilling injury. For example at 5°C, symptoms of chilling were still slight after 21 days (Table 3). For a given temperature and storage period, internal discoloration scores were generally higher than scores for other chilling related defects. The very high humidity environment (>95%) attained in the polybags resulted in a high incidence of decay in fruits stored at nonchilling temperatures (10° and 12.5°C).

In the second experiment eggplants of the 3 cultivars were stored on trays at 2.5°, 5°, 7.5° and 10°C (36°, 41°, 45° and 50°F) and evaluated every 3.5 days after transferring for 12 hours to 20°C. At 2.5°C, significant chilling symptoms (>slight or score of 2) appeared within 3.5 days on the 'Black Bell' but not on the Japanese or Chinese eggplants (**Tables 4, 5, 6**). At 5°C significant chilling symptoms appeared between 7 and 10.5 days on the 'Black Bell' and Japanese but not on the Chinese eggplants. At 7.5°C, between 10 and 14 days were required for chilling damage to be important on 'Black Bell', and between 14 and 17 days on Chinese eggplants. No chill injury was observed during 17 days at 10°C.

Figure 1 compares the development of fruit pitting and internal discoloration among the 3 types of eggplants. For the defect fruit pitting, 'Black Bell' eggplants were affected at 5°C, but fruits of the other two types were not affected notably. For internal discoloration, 'Black Bell' and Japanese fruits behaved similary with respect to storage temperatures and times. Internal discoloration required longer periods in the Chinese eggplants to reach the same degree of injury. **Figure 2** shows the development of discoloration (browning) on the fruit and calyx. The calyx developed more severe discoloration than the fruit in both 'Black Bell' and Chinese type eggplants. The calyx of 'Black Bell' eggplants showed more chill induced discoloration than did the calyx of the Chinese eggplants. This in part may be due to the difficulty in assessing the development of browning in the Chinese eggplant calyx since many fruits have a purple-green calyx and this may mask browning.

Figure 3 compares the changes in the visual quality of the fruit, calyx and the internal pulp for 'Black Bell' eggplants. Decline in calyx quality occurs prior to the loss of internal quality which in turn occurs before the loss of external fruit quality. In the Chinese eggplants, the decrease in visual quality of the fruit, calyx and the internal pulp are more closely associated in time (**Figure 4**).

Based on these two experiments, **Table 7** summarizes the estimated number of days to induce some chilling injury in the three types of eggplants. In general the 'Black Bell'

and Japanese eggplants behave similarly, although 'Black Bell' is slightly more chilling sensitive. The Chinese eggplants require longer at any given temperature to develop significant chilling symptoms.

Physical injury was an important defect, especially on the Japanese eggplants. These are damaged very easily with normal handling, scoring from moderate to moderately severe (Table 5). Because of the physical injury, visual quality scores of the Japanese eggplants were low after only 7 or even 3 days. The Chinese eggplants were quite resistant to physical injury (scored from none to slight) (Table 6) and the physical damage scores of the Black Bell eggplants were somewhat higher, but could still be described as "slight" injury (Table 4).

Weight loss was estimated over the 17 day storage period in the second experiment. **Figure 5** shows the estimated weight loss per day for the 3 types of eggplants stored at 2.5°, 5°, 7.5° and 10°C (36°, 41°, 45° and 50°F). The variety Black Bell had the lowest rate of water loss which is not surprising considering its surface:volume ratio in comparison to the elongated and smaller Japanese and Chinese types. Japanese eggplants had a very high rate of water loss and this in combination with physical injury leads to the rapid decrease in postharvest quality observed with this type of eggplant.

References

Esteban, R.M., E. M. Mollá, L.M. Robredo and F.J. López-Andréu. 1992. Changes in the chemical composition of eggplant fruits during development and ripening. J. Agric. Food Chem. 40: 998-1000.

Fallik, E., Y. Aharoni, S. Grinberg, A. Copel and J.D. Klein. 1994. Postharvest hydrogen peroxide treatment inhibits decay in eggplant and sweet red peppers. Crop Protection 13(6): 451-454.

Fallik, E., N. Temkin-Gorodeiski, S. Grinberg, I. Rosenberger, B. Shapiro and A. Apelbaum. 1994. Bulk packaging for the maintenance of eggplant quality in storage. J. Hort. Sci. 69: 131-135.

Fallik, E., N. Temkin-Gorodeiski, S. Grinberg, and H. Davidson. 1995. Prolonged low-temperature storage of eggplants in polyethylene bags. Postharvest Biol. and Tech. 5: 83-89.

Hardenburg, R.E., A.E. Watada, and C.Y. Wang. 1986. The commercial storage of fruits, vegetables, and florist and nursery stocks. USDA Agric. Handbook No. 66. Washington, D.C. 130 pp.

Kozukue, N., E. Kozukue, M. Kishiguchi and S.-W. Lee. 1978. Studies on keeping quality of and fruits III. Changes in sugar and organic acid contents accompanying the chilling-injury of eggplant fruits. Scientia Hort. 8: 19-26.

McColloch, L.P. 1966. Chilling injury of eggplant fruits. USDA Marketing Research Rpt. No. 749. 5 pp.

Mohammed, M. and L. Sealy. 1986. Extending the shelf-life of melongene (*Solanum melongena* L.) using polymeric films. Trop. Agric. (Trinidad) 63(1): 36-40.

Monteiro Sigrist, J.M. 1981. Physiological studies of harvested eggplant, *Solanum melongena* L. M.S. thesis, University of California, Davis. 127 pp.

Paull, R.E. 1990. Chilling injury of crops of tropical and subtropical origen. pp. 17-36. In: C.Y. Wang (ed.). *Chilling Injury of Horticultural Crops*. CRC Press, Boca Raton, Fl.

Tempkin-Gorodeiski, N., B. Sharpiro, S. Grinberg, I. Rosenberger and E. Fallik. 1993. Postharvest treatments to control eggplant deterioration during storage. J. Hort. Sci. 68: 689-693.

Table 1. Changes in quality of Japanese eggplants stored at different temperatures and evaluated after 7 and 14 days.

		Fruit Quality				**Calyx Quality**			**Internal Quality**	
Temp. °C	Days	Visual Quality[1]	Decay[2]	Discolor-ation[2]	Pitting[2]	Visual Quality[1]	Decay[2]	Discolor-ation[2]	Visual Quality[1]	Discolor-ation[2]
2.5	7	4.4	1.0	1.4	2.5	4.6	1.2	1.0	6.2	3.1
	14	1.1	2.0	4.0	3.8	2.0	2.5	1.5	1.0	5.2
5	7	5.2	1.0	1.0	1.0	4.9	1.2	1.0	7.6	2.1
	14	2.4	1.0	1.8	1.0	4.8	1.4	1.0	1.8	4.6
10	7	4.9	1.0	1.3	1.0	4.8	1.9	1.0	8.8	1.1
	14	2.8	1.2	1.8	1.0	4.4	2.3	1.0	8.4	1.3
12.5	7	4.1	1.0	1.0	1.0	4.9	2.1	1.0	9.0	1.0
	14	2.2	1.0	1.4	1.0	5.0	1.9	1.0	8.5	1.0
	lsd .05	0.4	0.1	0.3	0.4	0.3	0.1	0.1	0.4	0.2

[1] Visual quality was scored on a 9 to 1 scale, where 9 = excellent, 7 = good, 5 = fair, 3 = poor and 1 = unuseable. A score of 6 is the limit of salability.
[2] Defects are scored on a 1 to 5 scale, were 1 = none, 2 = slight, 3 = moderate, 4 = moderately severe, and 5 = severe.
[3] Data are the means of 5 to 8 eggplants per evaluation and treatment combination.

Table 2. Changes in quality of Black Bell eggplants stored at different temperatures and evaluated after 7, 14 and 21 days.

		Fruit Quality				Calyx Quality			Internal Quality	
Temp. °C	Days	Visual Quality[1]	Decay[2]	Discolor-ation[2]	Pitting[2]	Visual Quality[1]	Decay[2]	Discolor-ation[2]	Visual Quality[1]	Discolor-ation[2]
0	7	6.4	1.0	1.2	2.5	7.2	1.0	2.7	5.8	2.8
	14	5.1	1.0	2.5	2.6	5.5	1.0	3.3	1.7	4.8
	21	1.8	1.0	5.2	4.5	2.2	1.2	5.3	1.0	5.0
2.5	7	5.2	1.1	1.3	4.1	6.2	1.0	2.8	6.2	3.0
	14	3.6	1.0	3.8	3.3	4.9	1.0	3.9	1.7	4.5
	21	2.0	3.7	4.6	4.2	1.8	4.2	4.7	2.0	4.6
5	7	7.5	1.0	1.0	1.2	7.8	1.0	1.2	8.6	1.4
	14	2.8	1.0	3.3	4.8	7.1	1.0	2.3	2.7	4.3
	21	1.0	1.7	5.1	4.8	1.3	3.0	4.9	1.0	5.0
10	7	8.2	1.0	1.0	1.0	8.4	1.0	1.0	8.8	1.1
	14	7.9	1.0	1.0	1.0	7.5	1.4	1.8	8.5	1.4
	21	5.2	2.9	1.2	1.0	1.2	4.9	4.8	7.1	2.2
12.5	7	7.8	1.0	1.0	1.0	8.1	1.0	1.0	8.8	1.2
	14	7.8	1.0	1.0	1.0	7.3	1.6	1.7	8.9	1.1
	21	6.5	1.0	1.0	1.0	1.3	4.0	4.7	8.8	1.2
	lsd .05	1.0	0.2	0.2	0.2	0.5	0.2	0.3	0.9	0.2

[1] Visual quality was scored on a 9 to 1 scale, where 9 = excellent, 7 = good, 5 = fair, 3 = poor and 1 = unuseable. A score of 6 is the limit of salability.
[2] Defects are scored on a 1 to 5 scale, were 1 = none, 2 = slight, 3 = moderate, 4 = moderately severe, and 5 = severe.
[3] Data are the means of 5 to 8 eggplants per evaluation and treatment combination.

Table 3. Changes in quality of Chinese eggplants stored at different temperatures and evaluated after 7, 14 and 21 days.

		Fruit Quality				Calyx Quality			Internal Quality	
Temp. °C	Days	Visual Quality[1]	Decay[2]	Discolor-ation[2]	Pitting[2]	Visual Quality[1]	Decay[2]	Discolor-ation[2]	Visual Quality[1]	Discolor-ation[2]
0	7	6.3	1.0	1.9	2.3	7.9	1.0	1.1	6.3	2.6
	14	5.2	1.0	3.5	2.4	7.1	1.1	1.0	6.0	3.3
	21	2.4	1.9	4.3	3.8	3.6	2.4	3.9	2.3	4.4
2.5	7	6.8	1.0	2.2	2.5	7.0	1.0	1.0	7.8	2.3
	14	5.6	1.0	2.0	3.8	6.9	1.2	1.1	5.4	3.4
	21	2.3	2.1	4.2	4.2	3.9	2.6	2.4	3.0	4.1
5	7	8.3	1.0	1.0	1.0	8.0	1.0	1.0	7.9	1.8
	14	8.1	1.0	1.0	1.0	7.4	1.2	1.0	7.1	2.3
	21	7.7	1.0	1.1	1.4	4.1	2.8	2.3	6.6	2.5
10	7	7.9	1.0	1.0	1.0	7.5	1.2	1.0	8.4	1.4
	14	7.8	1.0	1.0	1.0	7.4	1.7	1.0	8.3	1.6
	21	7.4	1.3	1.0	1.0	4.0	2.8	2.6	8.5	1.5
12.5	7	8.2	1.0	1.0	1.0	7.1	1.6	1.0	8.5	1.4
	14	8.0	1.0	1.0	1.0	7.6	1.1	1.0	8.9	1.1
	21	7.6	1.3	1.0	1.0	4.1	2.7	2.6	8.9	1.1
	lsd .05	0.9	0.2	0.3	0.4	0.3	0.2	0.1	0.6	0.2

[1] Visual quality was scored on a 9 to 1 scale, where 9 = excellent, 7 = good, 5 = fair, 3 = poor and 1 = unuseable. A score of 6 is the limit of salability.
[2] Defects are scored on a 1 to 5 scale, were 1 = none, 2 = slight, 3 = moderate, 4 = moderately severe, and 5 = severe.
[3] Data are the means of 5 to 8 eggplants per evaluation and treatment combination.

Table 4. Changes in quality of Japanese eggplants stored at different temperatures and evaluated after 3, 7, 10, 14 and 17 days.

		Fruit Quality					**Calyx Quality**			**Internal Quality**	
Temp. °C	Days	Visual Quality[1]	Decay[2]	Discolor-ation[2]	Pitting[2]	Physical Damage[2]	Visual Quality[1]	Decay[2]	Discolor-ation[2]	Visual Quality[1]	Discolor-ation[2]
Initial		7.8	1.0	1.0	1.0	2.4	8.0	1.0	1.0	9.0	1.0
2.5	3	5.1	1.0	1.0	1.0	3.3	7.4	1.0	1.0	8.6	1.4
	7	5.2	1.3	1.3	2.0	2.9	7.1	1.0	1.0	6.5	2.7
	10	--	--	--	3.2	--	--	--	--	2.4	4.4
	14	--	--	--	3.8	--	--	--	--	2.4	4.6
	17	--	--	--	4.4	--	--	--	--	1.0	5.0
5	3	5.5	1.0	1.0	1.1	3.2	7.0	1.0	1.0	8.6	1.4
	7	5.2	1.0	1.0	1.0	3.6	7.3	1.0	1.0	6.2	1.8
	10	--	--	--	1.2	--	--	--	--	5.7	3.3
	14	--	--	--	1.0	--	--	--	--	4.0	3.7
	17	--	--	--	1.5	--	--	--	--	2.6	3.8
7.5	3	4.2	1.0	1.0	1.0	4.0	7.0	1.0	1.0	9.0	1.0
	7	3.4	2.2	1.2	1.0	3.7	6.1	1.2	1.5	8.4	1.6
	10	--	--	--	1.0	--	--	--	--	7.2	2.7
	14	--	--	--	1.0	--	--	--	--	8.2	1.7
	17	--	--	--	1.0	--	--	--	--	8.5	1.5
10	3	5.0	1.0	1.0	1.0	3.9	6.9	1.0	1.0	8.7	1.3
	7	4.4	1.0	1.0	1.0	3.9	7.2	1.0	1.0	9.0	1.0
	10	--	--	--	1.0	--	--	--	--	9.0	1.0
	14	--	--	--	1.0	--	--	--	--	8.8	1.2
	17	--	--	--	1.0	--	--	--	--	9.0	1.0
	lsd.05	1.1	0.3	0.2	0.1	0.3	ns	ns	ns	0.5	0.2

[1] Visual quality was scored on a 9 to 1 scale, where 9 = excellent, 7 = good, 5 = fair, 3 = poor and 1 = unuseable. A score of 6 is the limit of salability.
[2] Defects are scored on a 1 to 5 scale, were 1 = none, 2 = slight, 3 = moderate, 4 = moderately severe, and 5 = severe.
[3] Data are the means of 5 to 8 eggplants per evaluation and treatment combination.

Table 5. Changes in quality of Black Bell eggplants stored at different temperatures and evaluated after 3, 7, 10, 14 and 17 days.

		Fruit Quality					**Calyx Quality**			**Internal Quality**	
Temp. °C	Days	Visual Quality[1]	Decay[2]	Discolor-ation[2]	Pitting[2]	Physical Damage[2]	Visual Quality[1]	Decay[2]	Discolor-ation[2]	Visual Quality[1]	Discolor-ation[2]
Initial		8.2	1.0	1.0	1.0	2.0	8.3	1.0	1.0	8.2	1.5
2.5	3	8.1	1.0	1.1	1.0	1.7	7.2	1.0	2.4	7.8	2.2
	7	8.2	1.0	1.0	1.0	1.4	6.5	1.0	2.7	7.4	2.6
	10	6.6	1.0	1.6	2.4	1.6	5.1	1.0	4.3	3.6	3.7
	14	5.8	1.0	2.2	2.8	2.0	1.6	1.0	4.9	2.2	4.6
	17	3.8	1.2	3.6	3.2	1.9	1.0	3.2	5.0	1.0	5.0
5	3	7.9	1.0	1.0	1.0	1.9	7.6	1.0	2.0	7.9	1.9
	7	7.8	1.0	1.3	1.0	1.9	7.0	1.0	2.1	7.8	1.9
	10	7.7	1.0	1.2	1.2	1.7	5.6	1.0	4.0	5.2	3.5
	14	6.7	1.8	2.1	3.2	1.6	2.6	1.0	4.4	2.6	4.3
	17	6.0	1.4	2.4	2.6	1.7	2.8	1.4	4.3	1.0	5.0
7.5	3	7.8	1.0	1.0	1.0	2.2	7.8	1.0	1.8	8.5	1.5
	7	7.9	1.0	1.0	1.0	1.9	6.2	1.0	2.8	7.7	2.2
	10	7.2	1.0	1.0	1.0	2.1	5.7	1.0	3.6	7.6	2.0
	14	7.4	1.2	1.2	1.0	2.0	4.2	1.0	4.6	5.9	2.5
	17	7.1	2.0	1.7	1.1	1.9	2.0	2.4	4.8	4.8	3.5
10	3	7.7	1.0	1.2	1.0	1.9	8.0	1.0	1.4	8.0	1.6
	7	7.8	1.0	1.2	1.0	2.0	7.1	1.0	1.9	7.9	1.9
	10	7.2	1.0	1.0	1.0	1.9	5.9	1.0	3.1	7.7	2.2
	14	7.8	1.0	1.4	1.0	2.0	5.4	1.0	3.6	8.3	1.6
	17	7.1	1.6	1.4	1.0	1.8	5.1	1.2	3.5	7.8	2.0
	lsd.05	1.0	0.2	0.3	0.2	ns	0.5	0.1	0.1	0.5	0.2

[1] Visual quality was scored on a 9 to 1 scale, where 9 = excellent, 7 = good, 5 = fair, 3 = poor and 1 = unuseable. A score of 6 is the limit of salability.
[2] Defects are scored on a 1 to 5 scale, were 1 = none, 2 = slight, 3 = moderate, 4 = moderately severe, and 5 = severe.
[3] Data are the means of 5 to 8 eggplants per evaluation and treatment combination.

Table 6. Changes in quality of Chinese eggplants stored at different temperatures and evaluated after 3, 7, 10, 14 and 17 days.

		Fruit Quality					**Calyx Quality**			**Internal Quality**	
Temp. °C	Days	Visual Quality[1]	Decay[2]	Discolor-ation[2]	Pitting[2]	Physical Damage[2]	Visual Quality[1]	Decay[2]	Discolor-ation[2]	Visual Quality[1]	Discolor-ation[2]
Initial		9.0	1.0	1.0	1.0	1.5	8.9	1.0	1.0	9.0	1.0
2.5	3	8.2	1.0	1.2	1.0	1.2	8.5	1.0	1.0	8.6	1.4
	7	7.4	1.0	1.0	1.8	1.5	7.7	1.0	1.5	7.8	2.0
	10	5.5	1.0	2.4	3.6	1.0	7.1	1.0	2.2	8.0	2.8
	14	3.6	1.0	3.0	3.7	1.5	5.4	1.9	3.2	2.8	3.6
	17	3.9	1.9	4.0	4.4	1.7	2.8	2.6	4.0	2.6	4.3
5	3	8.1	1.0	1.0	1.0	1.6	8.6	1.0	1.0	9.0	1.0
	7	7.5	1.1	1.0	1.0	2.1	8.0	1.0	1.0	8.8	1.2
	10	8.0	1.0	1.0	1.2	1.8	7.9	1.0	1.0	8.0	1.7
	14	7.5	1.2	1.0	1.2	2.1	6.3	1.6	1.0	7.4	2.3
	17	6.5	1.1	1.6	2.0	1.8	4.7	2.5	3.6	6.1	3.0
7.5	3	7.9	1.0	1.0	1.0	1.7	8.5	1.0	1.0	9.0	1.0
	7	7.8	1.0	1.0	1.0	2.0	8.0	1.0	1.2	8.8	1.2
	10	8.0	1.0	1.0	1.0	1.7	8.2	1.0	1.0	8.5	1.5
	14	7.6	1.0	1.0	1.2	1.6	3.0	3.2	1.0	8.5	1.3
	17	6.2	1.0	1.0	1.0	1.7	3.0	4.0	2.7	8.5	1.4
10	3	8.2	1.0	1.0	1.0	1.3	8.4	1.0	1.0	8.9	1.1
	7	8.1	1.0	1.0	1.0	1.4	7.9	1.0	1.0	8.9	1.1
	10	7.8	1.0	1.0	1.0	1.6	7.9	1.1	1.0	8.6	1.3
	14	7.5	1.0	1.0	1.0	1.7	5.5	1.6	1.3	9.0	1.0
	17	7.0	1.0	1.0	1.0	2.1	5.2	2.0	2.7	9.0	1.0
	lsd.05	0.9	0.1	0.2	0.4	0.2	0.5	0.3	0.2	0.5	0.2

[1] Visual quality was scored on a 9 to 1 scale, where 9 = excellent, 7 = good, 5 = fair, 3 = poor and 1 = unuseable. A score of 6 is the limit of salability.
[2] Defects are scored on a 1 to 5 scale, were 1 = none, 2 = slight, 3 = moderate, 4 = moderately severe, and 5 = severe.
[3] Data are the means of 5 to 8 eggplants per evaluation and treatment combination.

Table 7. Estimated days to visual chilling symptoms that reduce marketability for 3 types of eggplants. Chilling symptoms included fruit pitting, discoloration of the fruit and calyx, and internal discoloration. Symptoms were considered to reduce marketability when scores exceeded 2.0 (slight) on a 5 point scale.

	Days to Visible Chilling Symptoms		
Temperature of Storage	Black Bell	Japanese	Chinese
0°C 32°F	1-2	--	2-3
2.5°C 36°F	4-5	5-6	5-6
5°C 41°F	6-7	8-9	10-12
7.5°C 45°F	12	12-14	15-16
10°C 50°F	no chilling	no chilling	no chilling

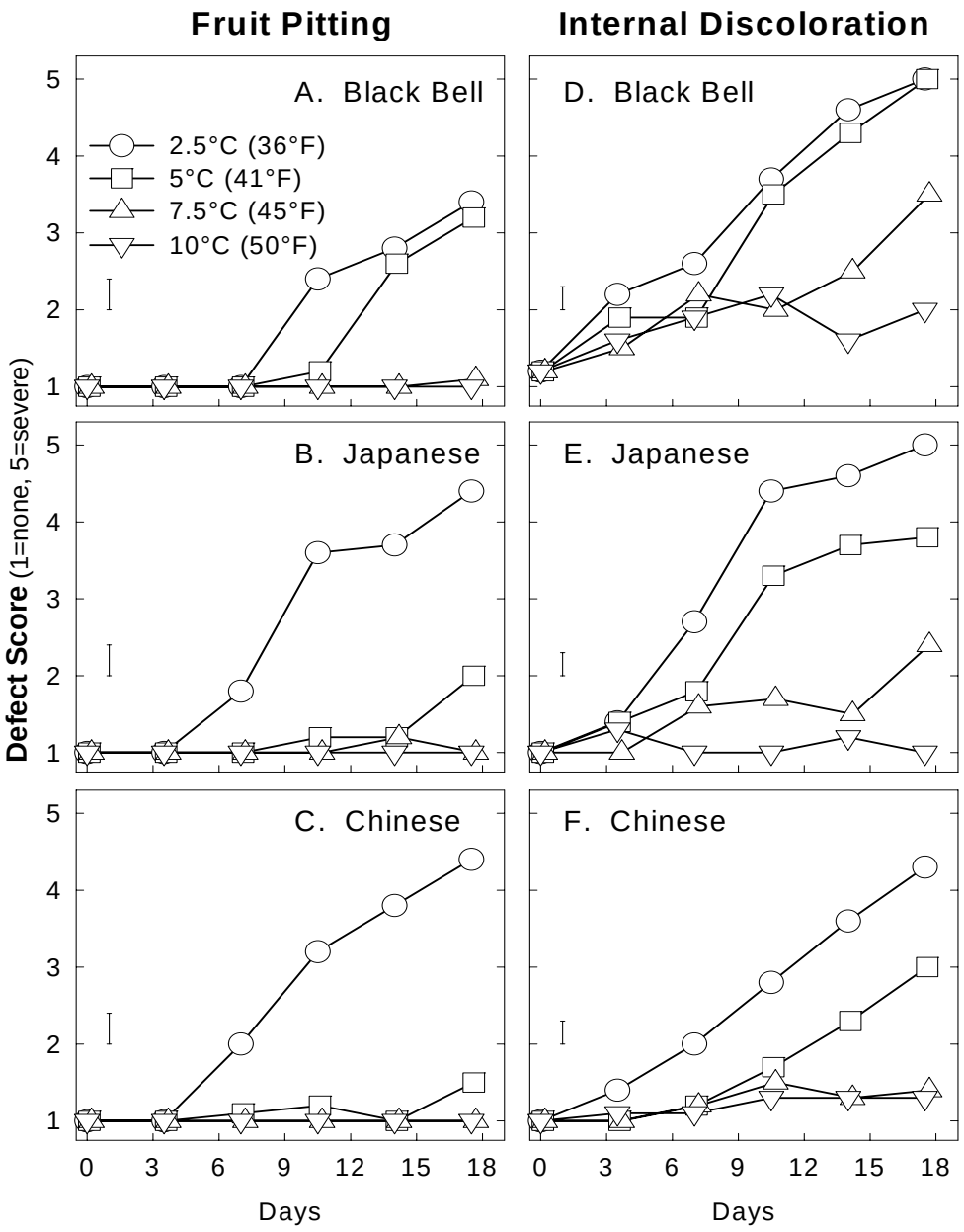

Figure 1. The development of the defects fruit pitting (A, B and C) and internal discoloration (D, E, and F) in 'Black Bell' (A, D), Japanese (B, E) and Chinese (C, F) eggplants during storage at 2.5°, 5°, 7.5° and 10°C (36°, 41°, 45° and 50°F). The data are means from 5 to 8 fruits per evaluation. The vertical bars represent the LSD at the 5% level.

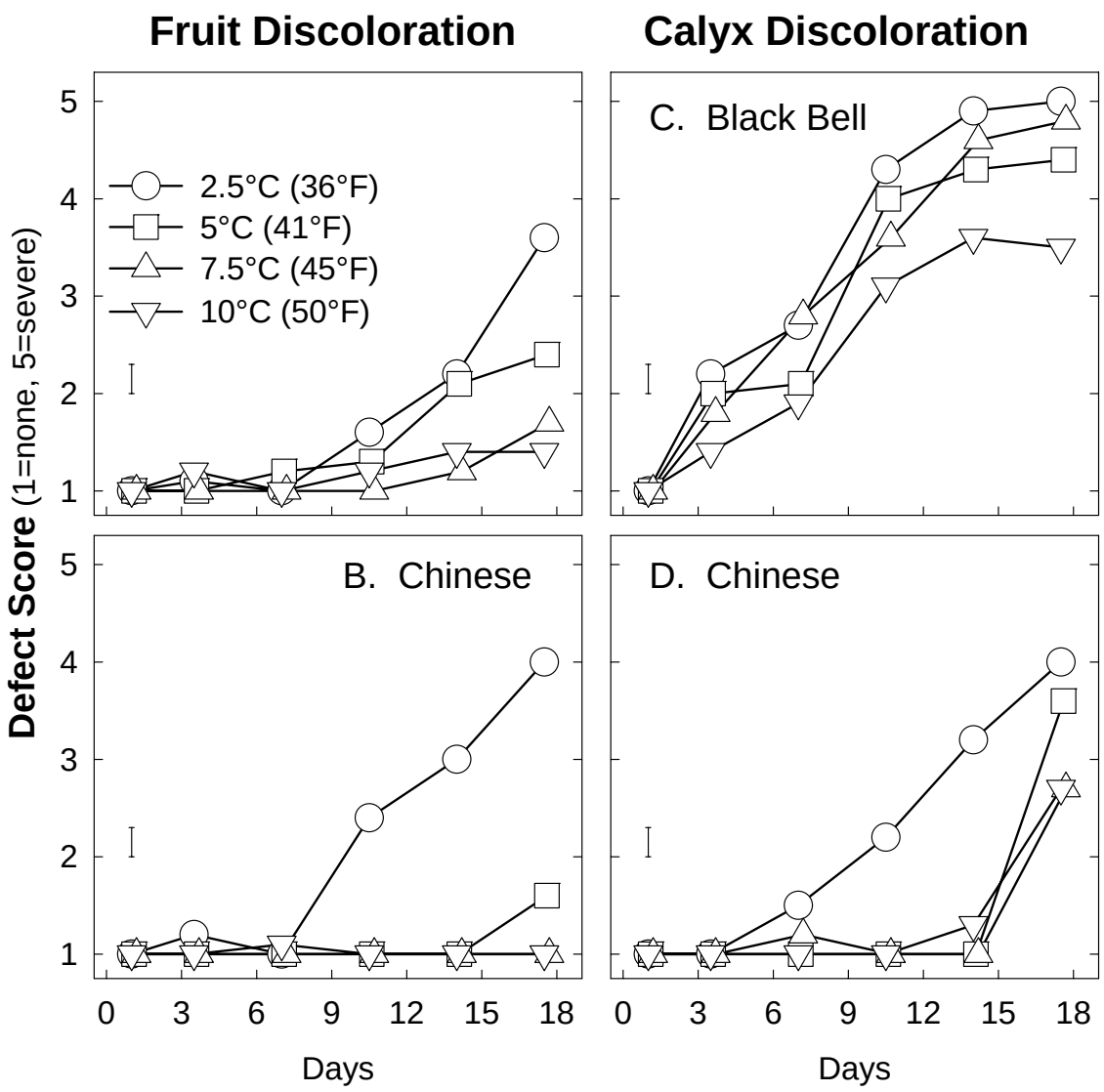

Figure 2. The development of the defects fruit discoloration (A, B) and calyx discoloration (C, D) in 'Black Bell' (A, C) and Chinese (B, D) eggplants during storage at 2.5°, 5°, 7.5° and 10°C (36°, 41°, 45° and 50°F). The data are means from 5 to 8 fruits per evaluation. The vertical bars represent the LSD at the 5% level.

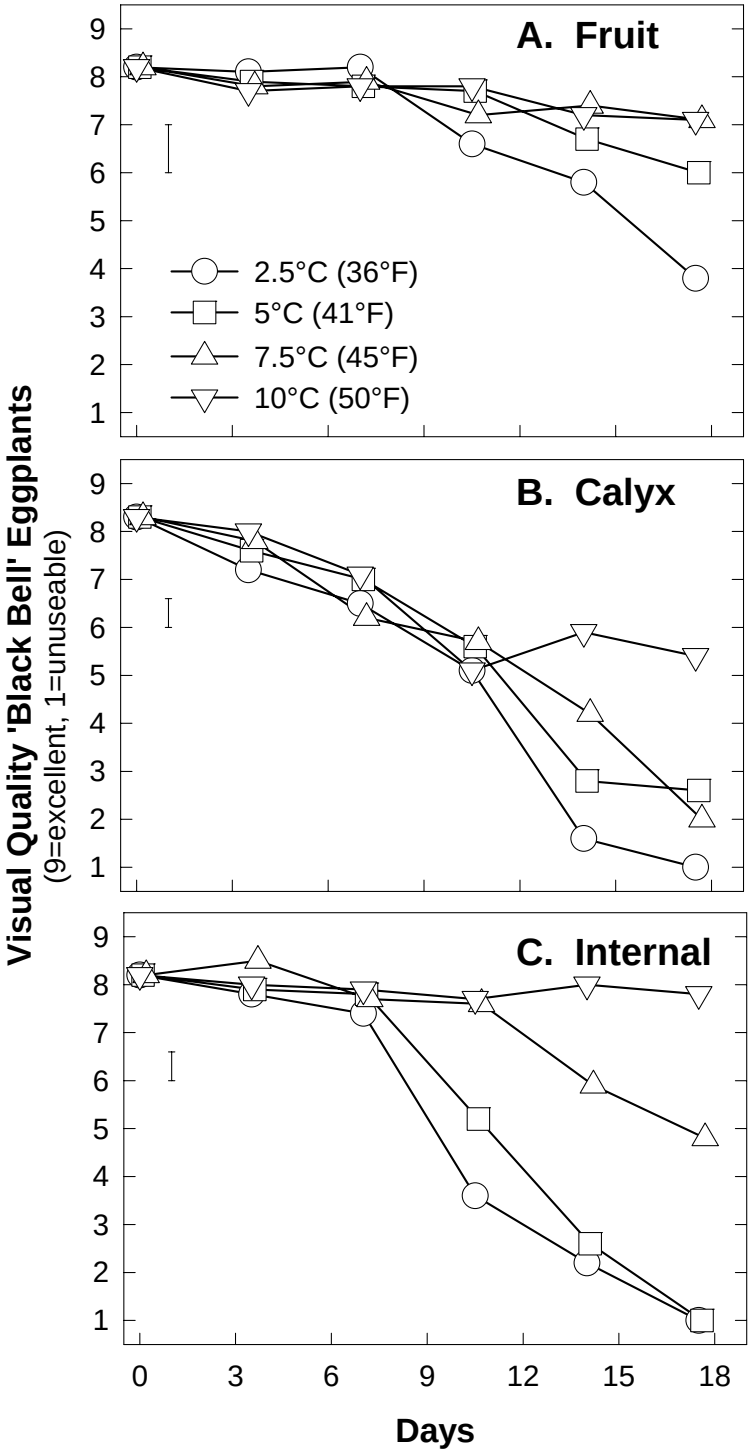

Figure 3. The visual quality of the fruit (A), calyx (B) and internal pulp (C) of 'Black Bell' eggplants during storage at 2.5°, 5°, 7.5° and 10°C (36°, 41°, 45° and 50°F). The data are means from 5 fruits per evaluation. The vertical bars represent the LSD at the 5% level.

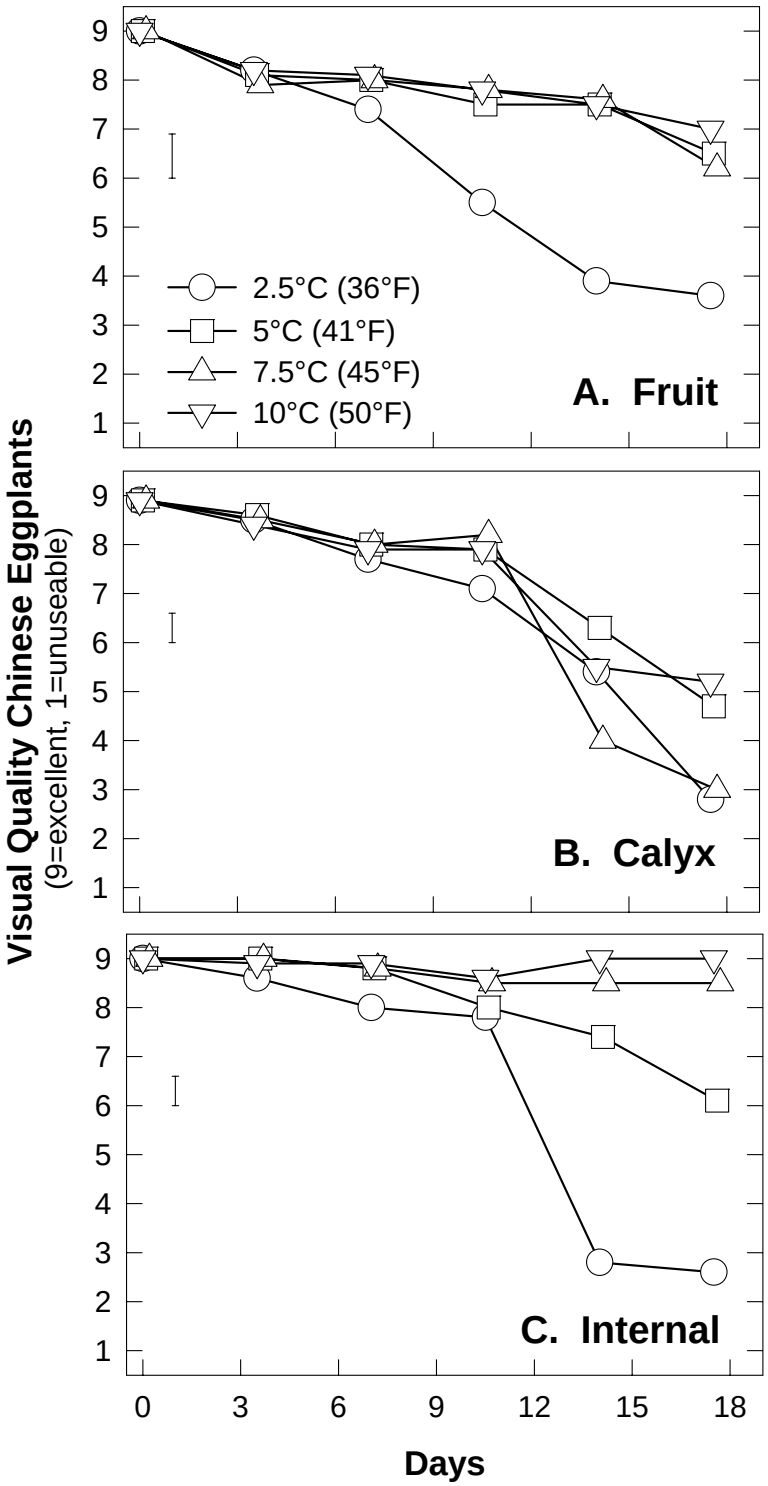

Figure 4. The visual quality of the fruit (A), calyx (B) and internal pulp (C) of Chinese eggplants during storage at 2.5°, 5°, 7.5° and 10°C (36°, 41°, 45° and 50°F). The data are means from 8 fruits per evaluation. The vertical bars represent the LSD at the 5% level.

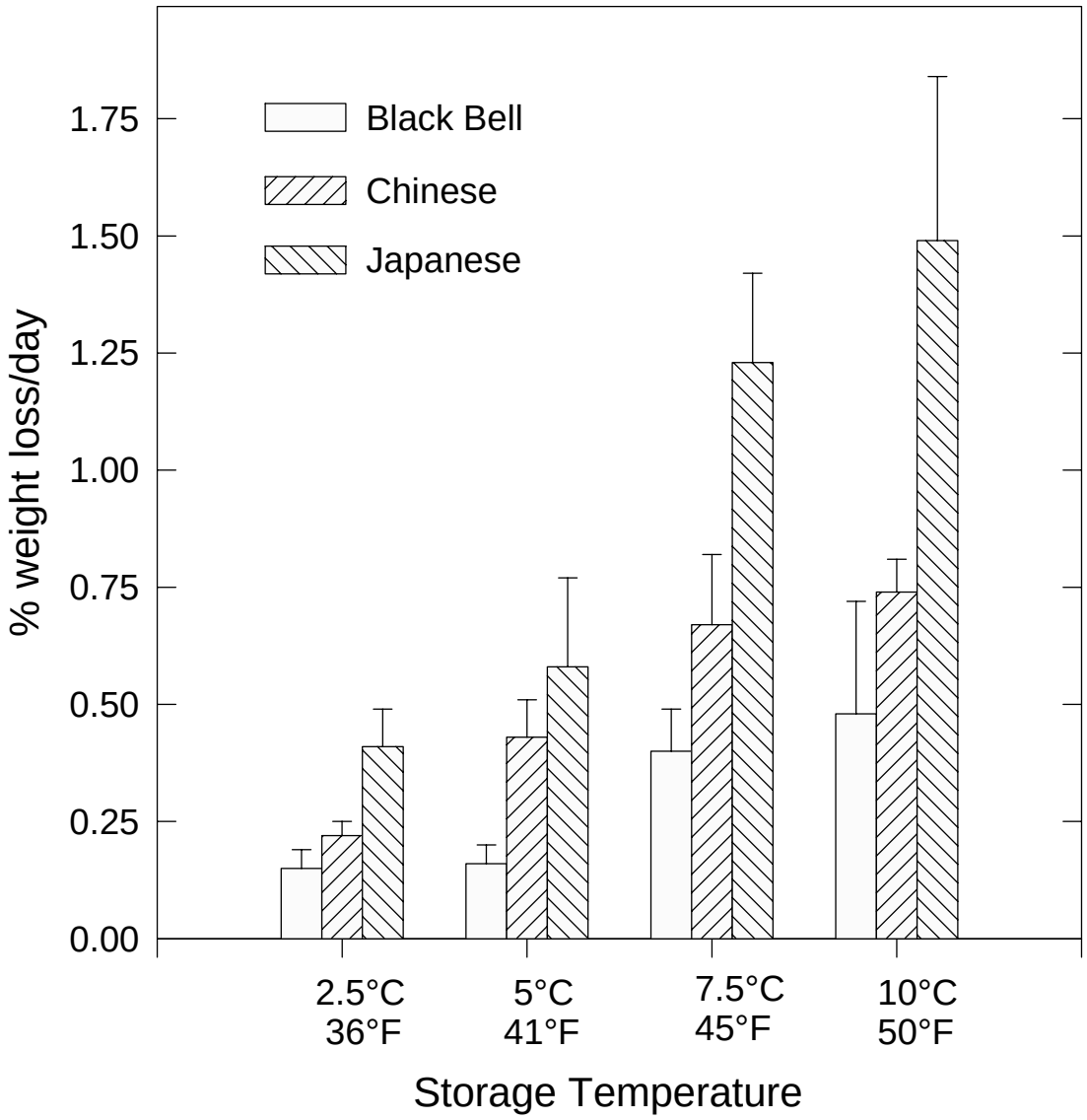

Figure 5. Average weight loss per day of 3 types of eggplants stored at 2.5°, 5°, 7.5° and 10°C (36°, 41°, 45° and 50°F). Fruits were stored on fiber trays overwrapped with a commercial food wrap. The data are means from 8 fruits per evaluation ± standard deviation.