QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

DIVISION OF PLANT INDUSTRY BULLETIN No. 842

CHILLING DISORDERS IN FRUIT OF THE CHOKO (SECHIUM EDULE)

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SUMMARY

Three physiological (chilling) disorders of the fruit of the choko (*Sechium edule* Sw) are described.

Fruit of the choko (also known as chayote, chocko, chow-chow, and chou-chou) were stored at 2·5, 5·0, 7·5, 10·0 and 12·5°C. Samples were removed from each temperature weekly and were examined for symptoms of physiological disorders. Three distinct disorders developed within 2 weeks: diffuse browning of the surface occurred only at 2·5°C; brown pitting of the surface occurred only at 5 and 7·5°C; internal browning of parenchyma occurred only from 5 to 10°C. All disorders developed only in fruit held at low (non-freezing) temperatures and are therefore considered to be chilling injuries.

I. INTRODUCTION

Chilling, or low temperature injury, occurs in many fruits which are stored at low, non-freezing temperatures. The temperatures at which chilling injury develops may be different depending on the fruit species and the duration of storage (see, for example, Fidler 1968; Fidler and Coursey 1969). Although subtropical and temperate fruits are susceptible to chilling, such disorders occur more rapidly, more severely, and at higher temperatures in tropical fruits.

Symptoms considered to be those of chilling were found in our laboratory during low temperature storage experiments with choko (a tropical species) in 1972, and brief descriptions (including coloured photographs) were published for the farming community (Littmann and Stolar 1973). No recording of this disorder of choko seems to have been made in the scientific literature, although chilling has been reported in the fruit of many other species of the family Cucurbitaceae (Lutz and Hardenburg 1968).

The aim of this work, therefore, was to provide detailed descriptions of the symptoms of chilling injuries in fruit of the choko.

II. METHODS

Fruit were harvested on two occasions from each of four farms in the Beerburrum district, 80 km north of Brisbane. Samples were selected from commercially-harvested fruit during the cooler months (May and July) and were transported to the laboratory and stored at 2·5, 5·0, 7·5, 10·0, and 12·5°C, within 12 h of harvest. These temperatures were selected because previous tests had shown that disorders should occur within this range, but not at 12·5°C.

Samples of fruit were removed from each temperature each week. Immediately after removal, all fruit of each sample were inspected externally, and half the fruit of each sample were inspected internally for disorder development. The other half of the fruit were examined both externally and internally after another 7 days at 20°C.

III. DESCRIPTIONS

Three disorders were observed. The main differences between disorders (distinguishing characteristics, time to and location of occurrence, and storage temperatures) are shown in table 1.

TABLE 1

THREE TYPES OF CHILLING INJURY IN FRUIT OF CHOKO (*Sechium edule*)

	Disorder 1. (Diffuse browning)	Disorder 2. (Brown pitting)	Disorder 3. (Internal browning)
FIGURE NO.	1	2	3
Temperature	2·5°C	5° – 7·5°C	5°C – 10°C
Time of first observed symptom	2 weeks	2 weeks at 5°C	1·5 weeks at 7·5°C
Location of first observed symptom	Epidermis	Epidermis (and some underlying cells)	Parenchyma (10–20 mm below surface)
APPEARANCE— Initial	Diffuse brown areas	Well defined brown spots	Light brown lesions
Later development	Darker brown diffuse areas. Heavily infected. Parenchyma cells leaking	Spots enlarge, become pitted, with necrotic centres. Underlying cells dry out	Develops 'ring' in transverse cross section, whole parenchyma becomes brown, dry and infected

Disorder 1. Diffuse browning (2·5°C).

Storage for 2 weeks at 2·5°C caused extensive areas of faint brown surface discoloration.

Browning often occurred first in the longitudinal grooves of the surface of the fruit. The margins of the brown areas were ill-defined (cf. Disorder 2, below). After longer periods of storage, the discoloration became darker, and more extensive.

Affected regions were susceptible to invasion by fungi, particularly when removed to higher temperatures. Because of the similar tone (degree of luminosity of colour) of the affected (brown) and unaffected (green) tissues, the disorder could not be recorded on black and white film. However, figure 1 shows a typical example of fungal growth (and therefore the approximate extent of the physiological disorder) on a fruit stored for 4 weeks at 2·5°C, followed by 7 days at 20°C.

At this stage, internal fruit tissues were also affected: slight thumb pressure on the fruit caused immediate development of dark, grey-green water-soaked lesions which could be seen in the uncut fruit, and in the underlying tissues in cut section.

This disorder was not found at 5°C or higher temperatures.

Disorder 2. Brown pitting (5° and 7·5°C).

This disorder typically commenced after 2 weeks' storage at 5°C (and later at 7·5°C) with the development of light brown or tan lesions on the surface of the fruit. Although of various shapes, the lesions at first were approximately circular, with diameters of about 10 mm. Compared with Disorder 1, the margins of the affected areas were well defined.

Over longer storage periods, the symptoms usually developed as follows: the lesion became sunken; the tissues at the centre of the sunken pit dried out and became whitish brown; small cavities sometimes occurred in the underlying tissue; the cavities extended to the surface, where splitting occurred in the dead tissue at the centre of the pit.

This stage may be seen in figure 2. The margins of the affected areas remained brown and some of the pits became infected.

The severity of the disorder increased with time, and large, infected lesions eventually developed on the fruit surface.

Disorder 3. Internal browning (5° to 10°C).

The internal symptoms of chilling at temperatures of 5° to 10°C are shown for four degrees of severity in figure 3. The first symptoms typically appeared as brown lesions, which were circular when viewed in transverse cross-sections of the fruit, but elongated when viewed in longitudinal cross section.

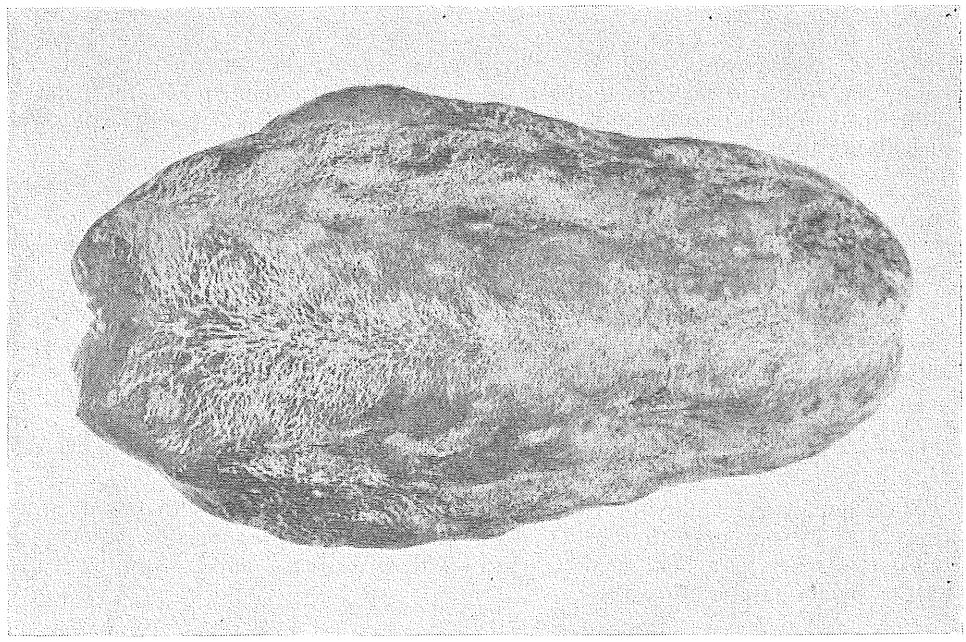

Figure 1. Fungal growth showing approximate extent of physiological disorder (Disorder I, diffuse browning) after storage at 2·5°C for 2 weeks.

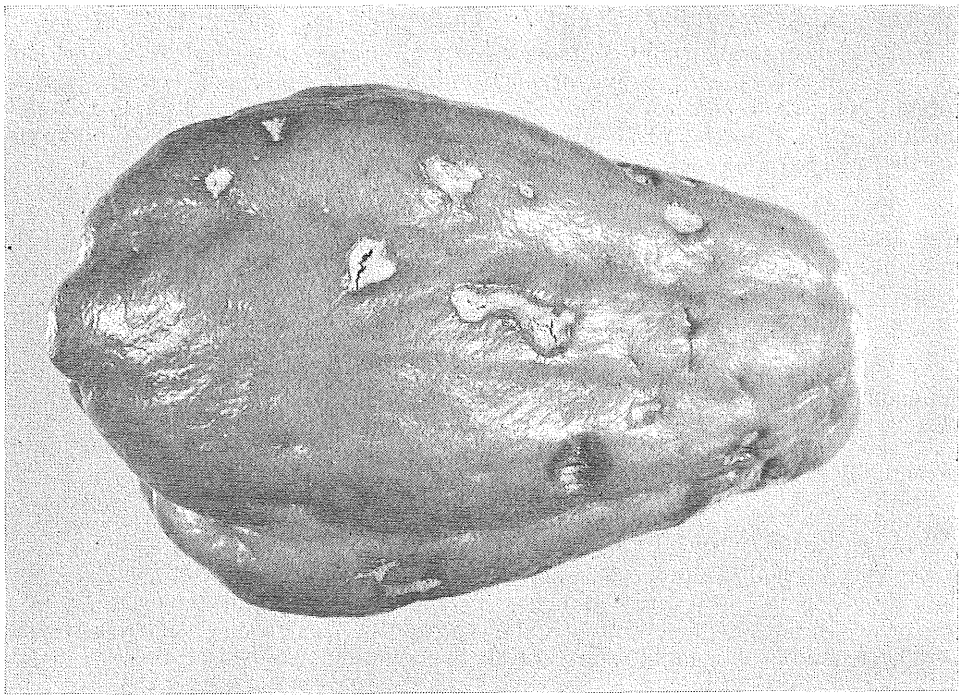

Figure 2. Brown pitting (Disorder 2) after storage at 5° to 7·5°C. Earliest symptoms appear after 2 weeks' storage.

The lesions were located in the ground parenchyma about 10 to 20 mm below the fruit surface, and developed at first towards either end of the fruit. A mild form of this disorder was recorded as early as 1 week after the fruit were placed in store.

As the disorder developed, the number and size of lesions increased so that when seen in transverse cross-section of a fruit the damaged areas fused, forming a ring which increased in thickness. Eventually, the whole of the parenchyma was affected.

The disorder occurred later with increasing temperature up to 10°C. At this temperature, the incidence of damage was very low, one or two small spots occurring in 2·6% of the fruit after 11 weeks' storage.

IV. SPROUTING

Although the ability of fruit to sprout may not be related to the disorders described, we observed that fruit held at temperatures producing Disorder 1 did not sprout when later held at 20°C. Fruit with Disorders 2 and 3 sprouted readily at the higher temperature.

It seems that the damage described as Disorder 1, evident throughout the whole of the fruit, indicates gross physiological dysfunction which includes interference with sprouting.

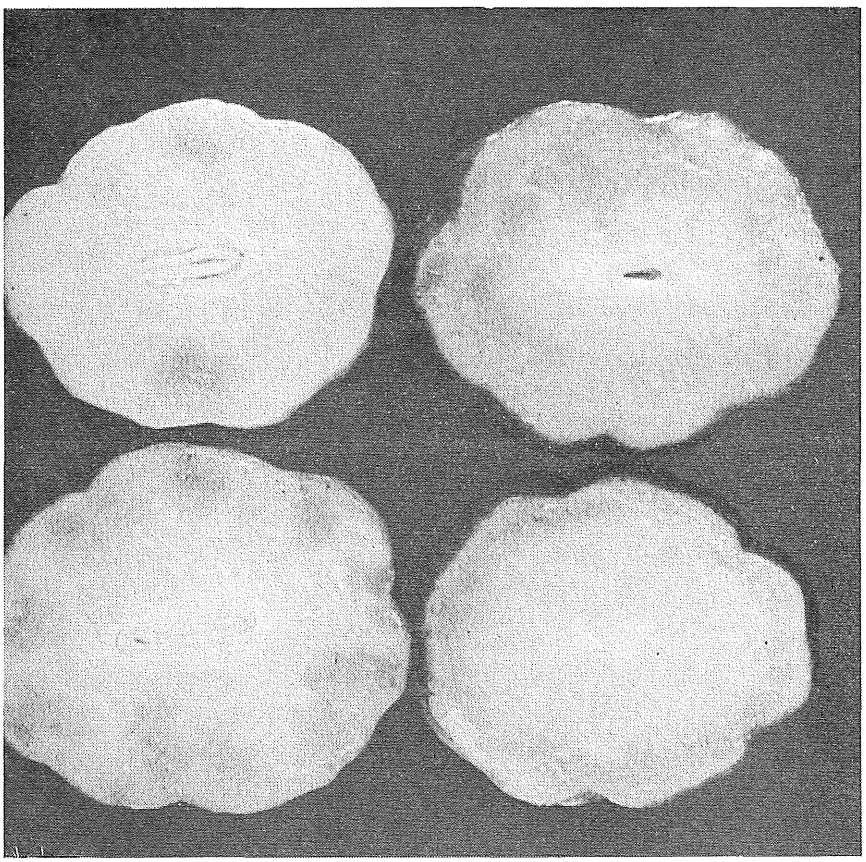

Figure 3. Internal browning (Disorder 3) after storage at temperature from 5° to 10°C. Top left: early stage showing few circular lesions. Bottom left: numerous lesions developing. Bottom right: lesions uniting to form ring of damaged tissue. Top right: most of parenchyma affected. Earliest symptoms appear after 1·5 weeks at 7·5°C.

REFERENCES

FIDLER, J. C. (1968).—Low temperature injury to fruits and vegetables. *In* J. Hawthorn and E. J. Rolfe, 'Low Temperature Biology of Food-stuffs' (Pergamon, Oxford).

FIDLER, J. C., and COURSEY, D. G. (1969).—Low temperature injury in tropical fruit. Proceedings, Tropical Products Institute Conference, 1969, pp. 103-110.

LITTMANN, M. D., and STOLAR, A. (1973).—Choko Storage and Disorders. *Queensland Agricultural Journal* 99:291-292.

LUTZ, J. M., and HARDENBURG, R. E. (1968).—The commercial storage of fruits, vegetables, and florist and nursery stocks. Agriculture Handbook, U. S. Department of Agriculture No. 66.

(Received for publication 17 August 1979)

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