

EFFECTS OF PREHARVEST CALCIUM SPRAYS ON THE OCCURRENCE OF BITTER PIT IN COOL-STORED APPLES

A market exists in the United Kingdom for Granny Smith apples shipped from Queensland in February. However, early apples of this variety, particularly those picked from young trees, are very susceptible to bitter pit, and the amount of this disorder which sometimes develops during transport could have a serious effect on exports to this market.

Many workers have studied the effect of mineral deficiencies in the fruit and the soil on the occurrence of bitter pit. The work of Garman and Mathis (1956) indicated that the incidence of bitter pit is related to the balance in the fruit between calcium and magnesium or calcium and magnesium plus potassium. They reduced bitter pit incidence by sprays and soil injections of calcium salts. Following this work, Askew and co-workers (1959, 1960) reduced bitter pit in Cox's Orange Pippin variety with sprays of calcium acetate. Martin and co-workers (Martin 1960; Martin, Lewis, and Cerny 1960) obtained reduction in the Cleopatra variety with summer sprays of calcium nitrate. Baxter (1960) reduced bitter pit in both the Granny Smith and the Cleopatra varieties with sprays of calcium nitrate, calcium chloride and calcium acetate.

This note reports the results of experiments carried out on tree spraying with calcium salts.

A block of young trees with a known history of high bitter pit incidence was selected in the Stanthorpe district. The trees had been planted in 1948–1950 with a spacing of 21 ft by 10 ft 6 in. Stocks used were approximately half Northern Spy and half Seedling. Only light crops had been obtained from the experimental trees and the crop during the 1960–61 season averaged 1½–2 bus per tree. The block of trees was divided into five sections and the experimental trees were randomized within each section so that five replicates of each treatment were used in the experiment.

Five separate treatments were used, namely—

- A. Calcium chloride sprays applied 5 times.
- B. Calcium nitrate sprays applied 5 times.
- C. Calcium chloride sprays applied twice.
- D. Calcium nitrate sprays applied twice.
- E. Untreated control.

The use of five separate spraying dates during the summer months for Treatments A and B was based on the work of Martin (1960). The concentrations and dates of application were—

December 12, 1960: 5 lb/100 gal at the rate of 200 gal/ac.

January 5, 1961: 5 lb/100 gal at the rate of 200 gal/ac.

January 19, 1961: 10 lb/100 gal at the rate of 200 gal/ac.

February 2, 1961: 10 lb/100 gal at the rate of 200 gal/ac.

February 5, 1961: 10 lb/100 gal at the rate of 200 gal/ac.

With Treatments C and D, the two sprays were applied on the same day, one early in the morning and the other in the afternoon. This was based on the work of Padfield and Bollard (1960), who found that trees treated in this way had less than 50 per cent. of the bitter pit in untreated controls and that the bitter pit present was less severe than in the controls. The sprays were both used at a strength of 10 lb/100 gal at the rate of 200 gal/ac. The date of application was February 5, 1961.

Three separate pickings were made from each tree used in the experiment, and each consisted of 50 fruit. The dates of pickings were—

First Pick (Maturity 1): February 6, 1961.

Second Pick (Maturity 2): February 17, 1961.

Third Pick (Maturity 3): February 28, 1961.

After picking, the fruit was inspected for bitter pit incidence, packed into half-bushel cases and carried by road to Brisbane, where it was stored at 36°F at the Food Preservation Research Laboratory. Fruit from each pick was held in cool store for five weeks, removed from store, held for seven days at normal atmospheric temperatures, and inspected for the incidence of bitter pit.

On each occasion, the inspection of the fruit immediately after picking showed that no bitter pit was present. The results of the inspection after five weeks' storage at 36°F followed by seven days at atmospheric temperatures are summarized in Table 1.

The effect of maturity on the incidence of bitter pit was significant. Fruit picked on February 17 had less bitter pit than fruit picked on either February 6 or February 28. It is not known whether time of picking is critical over the range of maturities studied and further work will be carried out to elucidate this.

While an inspection of the results indicates that sprays containing calcium salts did have some effect in reducing the incidence of bitter pit, an analysis of variance failed to reveal any significant differences between treatments, though five sprays of calcium chloride approached significance at the 5 per

TABLE 1
BITTER PIT INCIDENCE—EQUIVALENT PERCENTAGES*

Maturity	Calcium chloride 5 sprays	Calcium nitrate 5 sprays	Calcium chloride 2 sprays	Calcium nitrate 2 sprays	Control	Means
1	3.8	9.2	7.7	8.6	10.3	7.8
2	0.7	4.7	4.9	2.4	5.1	3.3
3	9.7	9.2	19.8	11.1	14.9	12.7
Means ..	3.9	7.6	10.0	6.8	9.7	7.4

* Inverse sine transformation.

No significant differences between treatments.

Maturity 2 significantly less than Maturities 1 and 3 (1 per cent. level).

Maturity 1 significantly less than Maturity 3 (5 per cent. level).

cent. level in fruit picked on February 17. These results are in accord with those of Padfield and Bollard (1960), who found that three sprays of an 8 lb/100 gal solution of calcium nitrate at 10-day intervals starting at first cover spray following blossoming, and fortnightly sprays of a 2 lb/100 gal solution of calcium nitrate from early December up to two weeks before picking, appeared to have no significant effect on bitter pit incidence in fruit from young trees.

All the calcium chloride spray treatments caused slight to severe marginal leaf scorch on the sprayed trees. However, this scorching appeared to have no apparent damaging effect on the health of the trees.

In view of these results, the use of preharvest sprays of calcium nitrate and calcium chloride for the control of bitter pit in fruit from young trees cannot be recommended and this type of fruit should be excluded from export consignments until further information is available on the effect of time of picking.

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C. D. STEVENSON,
Queensland Department of Agriculture and Stock.

The following is a list of the papers presented at the meeting of the Queensland Fruit Storage Investigators held at Sherbrooke, Queensland, on November 7-10, 1960. The papers were presented by the following persons: D. Martin, T. L. Lewis, J. Cerny, C. S. Padfield, E. G. Bollard, and C. D. Stevenson.

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1. Bitter pit in the apple variety Cleopatra in Tasmania in relation to calcium and magnesium. J. Cerny, T. L. Lewis, and D. Martin. *Aust. J. Agric. Res.* 11:742-9.

2. Fruit storage research at the Fruit Research Division, D.S.I.R. New Zealand—Summary of work for period 1958-1960. C. S. Padfield and E. G. Bollard.

3. Bitter pit 1935-1959. D. Martin.