FURTHER INVESTIGATIONS INTO THE EFFECT OF "STOP-DROP" SPRAYS ON THE COOL-STORAGE BEHAVIOUR OF DELICIOUS APPLES

Stevenson and Dodd (1961) showed that the cool-storage life of Queensland-grown Delicious apples was deleteriously affected by alpha naphthalene acetic acid (NAA) sprays when compared with untreated controls and 2,4,5-trichlorphenoxy-proprionic acid (2,4,5-TP) sprays, the difference being mainly due to the higher incidence of superficial scald. Further investigations were carried out to determine whether seasonal variation has any effect on the performance of 2,4,5-TP and NAA. In addition, as Stevenson and Blake (1961) obtained good scald control in cool-stored Queensland Granny Smith apples by chemical means, the effect of post-harvest dips of ethoxyquin on scald control on the Delicious variety was also studied.

Methods and Materials

Fruit for the experiment was obtained from the same three orchards in the Granite Belt, surrounding Stanthorpe, as in the 1961 investigations. In each orchard, the same trees as used in 1961 were used in the 1962 investigations. Three treatments were used and the sprays were applied to each tree on February 16, 1962. Treatments were as follows:—

Untreated control

2,4,5-TP spray—20 p.p.m.

NAA spray—10 p.p.m.

Rate of coverage used for each treatment was 2 gal per tree at 200 lb/in^2. The fruit was picked on three separate occasions:

First pick (Maturity 1)—February 20, 1962

Second pick (Maturity 2)—March 3, 1962

Third pick (Maturity 3)—March 13, 1962

In this experiment, fruit was picked over a wider range of maturities than in the 1961 investigations, to determine the effect of picking date on storage disorders within the experiment. Three half-bushel cases from each picking date were taken from each of the three treatments from each of the six blocks of trees, making a total of 54 half-bushel cases for each of the three picks. Prior to packing, the fruit was dipped in a 2000-p.p.m. emulsion of ethoxyquin to which a small amount of a non-ionic wetting agent had been added to ensure uniform fruit coverage. The

fruit was then packed in the field and railed to Brisbane, where it was stored at the Food Preservation Research Laboratory, Hamilton, at 34°F. Removals of the fruit from store were made on three occasions:

Removal 1—August 7, 1962

Removal 2—September 4, 1962

Removal 3—October 9, 1962

After removal from the storage chamber, the fruit was held at 70°F for seven days and then inspected for disorders. Firmness was measured by means of a Magness penetrometer, using the $\frac{7}{16}$-in. plunger. Five fruits from each case were taken as a sample and readings taken on opposite sides of each fruit. The means of the 10 readings were recorded.

Results

The results are summarized in Table 1. Incidence of superficial scald, mould and bitter pit was slight, and for this reason no analyses of variance were carried out on these results. While only small numbers of these disorders were present, there is a suggestion that fruit from the trees treated with NAA and 2,4,5-TP was more susceptible to both superficial scald and bitter pit. In addition, the incidence of these disorders decreased with increase in maturity of the fruit. This effect of decrease in scald incidence with increase in maturity has been observed in many apple varieties and has been reported in the Delicious variety by Stevenson (1959). The incidence of breakdown was high, and was significantly affected by maturity, treatment and length of the storage period. Also, fruit from the untreated controls had significantly less breakdown than that from either the NAA or 2,4,5-TP treated trees.

The number of total disorders present, comprising the total of superficial scald, mould, bitter pit and breakdown, was significantly affected by maturity, treatment and length of the storage period. Fruit from Maturities 1 and 2 had fewer disorders than that from Maturity 3. This is in accord with the results of Stevenson (1959), who found that the period covered by Maturities 1 and 2 (i.e. late February to early March) was the least susceptible to storage disorders for the Delicious variety. There were fewer disorders in fruit from the untreated controls than in either the NAA or 2,4,5-TP treatments. Disorders were less prevalent in the first removal than in either of the two later removals. Firmness was affected by both maturity and length of the storage period, but treatment had no significant effect on firmness of the fruit. This is in agreement with the work of Stevenson and Dodd (1962).

TABLE 1

EQUIVALENT PERCENTAGES OF DEFECTS AND FIRMNESS OF DELICIOUS APPLES AFTER REMOVAL FROM COOL STORE

—	Superficial Scald	Mould	Bitter Pit	Breakdown	Total Disorders	Firmness (lb)
Removal 1						
Maturity 1	4·9	2·5	10·3	3·9	16·7	9·72
Maturity 2	1·0	0·6	7·0	8·7	17·6	8·60
Maturity 3	0·0	1·9	0·6	14·4	19·3	8·46
NAA spray	2·1	1·6	6·2	12·1	20·9	8·86
2,4,5–TP spray	2·5	1·5	6·7	9·2	21·1	8·78
Control	1·3	1·9	5·0	5·0	12·2	9·14
Removal 2						
Maturity 1	3·3	0·8	9·5	4·4	15·4	9·88
Maturity 2	0·6	0·7	5·4	11·9	17·2	8·81
Maturity 3	0·1	1·7	0·9	34·6	39·0	8·69
NAA spray	2·0	1·3	9·0	18·3	28·3	9·09
2,4,5–TP spray	1·3	1·1	3·8	20·4	28·6	9·12
Control	0·7	0·8	3·1	7·7	13·9	9·16
Removal 3						
Maturity 1	2·6	3·1	5·5	4·6	15·9	9·30
Maturity 2	0·8	1·3	3·4	12·6	18·1	9·03
Maturity 3	0·2	4·9	0·7	46·5	56·2	6·66
NAA spray	2·4	2·0	4·7	21·9	32·8	8·44
2,4,5–TP spray	0·9	3·7	3·9	16·7	29·8	8·02
Control	0·3	3·5	0·9	16·7	23·9	8·52

Superficial scald—No analysis of variance carried out

Mould—No analysis of variance carried out

Bitter pit—No analysis of variance carried out

Breakdown—Maturity 1 sig. less than Maturity 2 (1% level)
Maturity 2 sig. less than Maturity 3 (1% level)
Removal 1 sig. less than Removals 2 & 3 (1% level)
Control sig. less than NAA (1% level)
Control sig. less than 2,4,5-TP (5% level)
Maturity X Removal interaction: Removal effect more marked with Maturity 3

Total Disorders—Removal 1 sig. less than Removal 3 (1% level)
Maturities 1 and 2 sig. less than Maturity 3 (1% level)
Control sig. less than NAA and 2,4,5-TP (1% level)
Maturity X Removal interaction: Removal effect occurs at Maturity 3 only

Firmness—Removal 2 sig. firmer than Removal 3 (1% level)
Removal 1 sig. firmer than Removal 3 (5% level)
Maturity 1 sig. firmer than Maturity 2 (1% level)
Maturity 2 sig. firmer than Maturity 3 (1% level)
Maturity X Removal interaction: Removal effect occurs at Maturity 3 only

DISCUSSION

Superficial scald incidence was much less than in the 1961 experiment (Stevenson and Dodd 1962). This can be attributed to the use of post-harvest ethoxyquin dips, and to the later picking dates in the 1962 season. However, the concentration used—2,000 p.p.m.—did not eliminate the disorder. Hall, Scott, and Coote (1961) have shown that concentrations of scald inhibitors must be varied to suit the susceptibility of the fruit to the disorder and slightly higher concentrations of ethoxyquin may be necessary to effect complete control.

The results show that storage behaviour was generally deleteriously affected by both NAA and 2,4,5,-TP sprays when compared with untreated controls. This was mainly due to the higher incidence of breakdown in fruit from the second and third picks. Breakdown was significantly greater in treated fruit than in untreated controls from the first pick, but its incidence was not very high. The increased amount of other disorders, particularly bitter pit, in the treated fruit was largely responsible for significant differences between fruit treated with NAA and 2,4,5-TP and the untreated controls, in fruit from this pick.

For these reasons, long storage of fruit from trees sprayed with "stop-drop" sprays of NAA or 2,4,5-TP cannot be recommended.

As reported by Stevenson and Dodd (1962), the 1961 results showed that fruit from the untreated controls and the 2,4,5-TP sprays stored significantly better than that from the NAA sprays. This significant difference was due to the high incidence of superficial scald, particularly in the NAA treatment, breakdown and other disorders being negligible. Significant differences in the 1962 results are mainly due to the high incidence of breakdown in the sprayed trees, and 2,4,5-TP in this year no longer stands out as a better treatment than NAA. However, in neither year has 2,4,5-TP been shown to be worse than NAA with respect to storage behaviour, which is at variance with grower opinion that 2,4,5-TP when used as a "stop-drop" spray affects storage behaviour more than NAA. As 2,4,5-TP gives a 26-day protection from preharvest drop, compared with a 14-day protection from NAA, the Departmental recommendation of 2,4,5-TP in preference to NAA is valid from both the effect on preharvest drop and storage behaviour.

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(Received for publication January 29, 1963)

S. G. REID, Government Printer, Brisbane