APPLE FRUITLET ANALYSIS

Mineral analyses of fruitlets, and fruit, from New Zealand orchards during the 1992/93 and 1993/94 season suggested that early season fruitlet analysis can help growers to assess the degree of risk of mature fruit having unacceptably low concentrations of calcium. Additional trials conducted in 1997/98 confirmed the earlier findings and also suggested that apple fruitlet data may be a better indicator of storage quality than pre-harvest fruit testing.

Some varieties of apple are particularly susceptible to post-harvest disorders, such as bitter pit, when their mineral composition is out of balance. Considerable scientific research in New Zealand has been - and continues to be - undertaken into ways of preventing these disorders, and of predicting the risk of their development.[1]

Limitations of Soil or Leaf Tests

Although soil and leaf tests are valuable management tools for maintaining the health and vigour of the trees themselves, such tests have proved of limited value for assessing the risk of post-harvest disorders in mature fruit, because “soil, leaf and fruit nutrient contents [are] generally not well correlated with one another...[This is] attributed to the empirical nature of soil tests, the presence of large nutrient reserves within the tree framework, and the effects of cultural and environmental factors in nutrient uptake and translocation by the trees.” [2]

Mineral Analysis of Mature Fruit

Mineral analysis of mature fruit is generally held to be a reasonable predictor of storage disorders. For example low concentrations of calcium in the fruit at harvest have been associated with “the storage disorders bitter pit and senescent breakdown in Cox’s Orange Pippin and lenticel blotch pit in Braeburn”; and abnormal levels of other nutrients (e.g. potassium) can also contribute to storage disorders.

However there are only limited remedies available to growers who discover that their fruit has these mineral imbalances at harvest.

Early Season Fruitlet Analysis

The concept of early season fruitlet analysis has been investigated, in an effort to find out whether post-harvest storage disorders can be predicted earlier in the growing season. The results of this research have shown that the earlier in the season the analysis is performed, the more difficult it is to predict post-harvest disorders. For example, Belgium researchers[3] found between 18% and 41% of the variance in long-term keeping qualities of the apple variety Jonagold could be predicted by early season mineral analysis of fruitlets. They concluded that it would be difficult to predict “very precisely the storage potential of an individual fruit sample” from such early season analysis since “mineral fruit composition is only one of numerous factors playing a role in storage.”

Predicting Potential Grading Problems

This laboratory has a long and close relationship with individual apple growers, and their merchant suppliers; and we know that growers would welcome prior warning of mineral imbalances in their harvested fruit, especially as these imbalances might adversely effect their crop’s calcium status at harvest. With prior warning, growers might be able to take a range of corrective actions such as pruning, spraying, or tree nutrition measures.

During the 1992/93 and 1993/94 seasons, Analytical Services Laboratory - with the support of Phosyn plc - analysed***note 1*** more than 300 samples of Braeburn and Cox’s Orange fruitlets selected early in the growing season. The fruitlet test results were then correlated with corresponding mineral analyses of mature fruit taken from the same orchard blocks at the end of each season.

The objective of our research was to compare the apples mineral levels early in the season with those at harvest, to see whether growers could use early season mineral analyses of fruitlets to predict potential fruit grading problems at maturity.

The next advance in the use of apple fruitlet testing compared fruit storage characteristics with fruitlet calcium level.

This investigation in 1997 involved fifty blocks (seventeen Cox Orange Pippin (COP) and thirty-three Braeburn), selected from both the Hawkes Bay and Nelson areas. They were selected after fruitlet analysis results were completed. Because of the limited resources available, it was decided to select properties that either showed a high or low fruitlet calcium status, with the focus being whether or not these fruit developed storage disorders.

The results of this work are shown diagrammatically in Table 1 and provides a clear comparison of the two testing approaches.

Table 1: Summary of Trial Results

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	% samples showing less than 5% Pit	% samples showing more than 5% Pit
Calcium in Fruitlet:		
Braeburn		
Above 8.5 mg/100g	71	29
Below 8.5 mg/100g	19	81
Cox Orange Pippin:		
Above 8.5 mg/100g	88	12
Below 8.5 mg/100g	33	67
Calcium, at Harvest:		
Braeburn:		
Above 2.2 mg/100g	55	45
Below 2.2 mg/100g	31	69
Cox Orange Pippin:		
Above 2.2 mg/100g	57	43
Below 2.2 mg/100g	60	40

Other Mineral elements

Although calcium was the focus of our study, fruitlets and fruit were analysed for other mineral elements too. In situations where absolute calcium levels are low, it may be useful to consider the level of calcium relative to other minerals such as the ratios of nitrogen to calcium, and (potassium + magnesium) to calcium.
Following a change in laboratory processes in 2022, reports will show the measured mineral levels for samples as a table only. A new technical note has been created that shows typical values for apple (non-specific for variety), based on analysis of fruitlets of similar weight. (Refer to Technical Note – Typical Apple Fruitlet and Fruit Mineral Levels)
Adequate levels of Phosphorus are necessary to ensure fruit firmness and avoid problems of fruit breakdown e.g. Low Temperature Breakdown (LTB), particularly when fruit calcium levels are also low.
Although calcium supply during fruit formation is important, other factors known to influence the final storage quality are:

- Rate of fruit growth. Fast growing results in lower calcium levels.
- Crop loading. Light cropping trees tend to have low fruit calcium.
- Poor pollination giving low seed number is associated with low fruit calcium.
- Vigorous summer shoot growth competes for nutrient supply.
- Elevated magnesium, potassium and nitrogen levels can exacerbate marginal calcium status.
- Leaf area on fruiting spurs and laterals. Low leaf areas mean lower fruit calcium.

Note 1 Method Used
Growers participating in the study selected apple fruitlets up to 35gms in weight. Analysis during the first season showed that the ideal weight range was between 20 gms and 35 gms, corresponding to fruitlets 100mm in circumference. Fruitlets less than 20gms were too immature to provide reliable correlation. Mineral analyses for a wide range of nutrients, together with key nutrient ratios, were undertaken on the whole fruitlet, and (later) the whole fruit, including core material but excluding pips. This approach follows that of some European researchers, but differs from the procedure used in the industry for grading purposes (where a mid-flesh sample is taken for mature fruit analysis.)

1. Assessment and reduction of bitter pit risk in apple fruit. Ferguson, IB; Watkins, CB; Volz, RK.; Hort. & Food Res Inst. of NZ; *Acta-Horticulturae 1993, No.326, 157-164.*
2. Nutrient Status of Apple Orchards in Canterbury, New Zealand. Level in Soil, Leaves, and Fruit and the Prevalence of Storage Disorders. Haynes, RJ, MAF Technology, Lincoln, *Communications in Soil Science and Plant Analysis 1990,21:11-12, 903-920.*
3. Relationship between Fruit Mineral Composition and Storage Life of Apples, CV. Jonagold. Marcelle, RD; Porreye, W; Deckers, T; Simon, P; Research Station of Gorsem Brede Akker, Belgium; Acta Horticulturae 1989, No. 258, 373-377

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