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NSW DEPARTMENT OF
PRIMARY INDUSTRIES

Bitter pit in apples

Agfact H4.AC.1, second edition 2004

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External skin pits on Braeburn apples.

Internal corky spots in Braeburn apple. Note that damage is concentrated near the skin.

Bitter pit is a nutritional disorder of apples caused by calcium deficiency in the fruit as it matures. It results from a complex relationship between climate, nutrition and tree vigour. Bitter pit symptoms often occur prior to harvest, or after long-term storage.

SYMPTOMS

The disorder starts internally, but as it worsens external blemishes develop on the skin. Badly affected flesh often has a bitter taste—hence the name 'bitter pit'.

Small bruise-like spots, which may be darker than the surrounding tissue, develop on the skin. As the disorder worsens the spots become brown and sunken to form 'pits' about 3–6 mm in diameter. The spots become sunken when the cells underneath dry out and shrink, becoming tough and spongy.

The spongy areas may look cone-shaped when the fruit is cut in half. Brown areas about the same diameter of surface spots may also develop further into the flesh in severe cases, though symptoms most commonly occur close to the skin.

Spots usually develop first at the calyx end of the fruit, but highly susceptible varieties can be damaged right up to the shoulder. Often the damage is more obvious on the shaded side of the fruit where the skin is lighter in colour.

External bitter pit symptoms often worsen when fruit is cold stored. Fruit with no obvious symptoms at harvest can develop skin pitting in storage, resulting in unexpected loss.

FACTORS FAVOURING DEVELOPMENT

Bitter pit can occur even in soils with good levels of calcium. Calcium (Ca) moves from the roots into the xylem and is carried to areas where transpiration occurs. It moves slowly into other parts of the plant. Bitter pit results when there is competition between leaves and fruit for calcium.

Calcium uptake can be influenced by several factors.

1) Water availability

Calcium is transported in the transpiration stream. Low soil moisture reduces the ability of the tree to take up calcium from the soil and transport it to the fruit.

It is essential that adequate water is available to the tree during cell division and cell expansion stages to maximise calcium uptake.

2) Climatic factors

Hot, dry weather during fruit growth can cause the calcium to concentrate in the leaves if soil moisture levels are low. Excessively hot days will cause trees to shut down by closing the leaf stomates to reduce water loss through transpiration. When transpiration stops, calcium transport in the plant is reduced.

3) Nutrition

Nitrogen (N): Excess nitrogen favours vegetative growth. Fruit does not receive enough calcium when it has to compete with shoot growth. Nitrogen should only be applied at levels that maintain balanced fruit and leaf growth.

Potassium (K) and magnesium (Mg): Excessive amounts of these two nutrients can directly compete with calcium within the fruit cells. K, Mg and Ca are chemically similar in that they are all positively charged ions. Due to their chemistry K and Mg are often taken up in preference to calcium.

Soil and tissue testing results should be used to guide fertiliser decision making and to ensure that the plant has balanced nutrition. Check the soil pH, as calcium uptake can be limited if it is less than 6.0.

4) Tree vigour

Bitter pit occurs more commonly on young trees and mature trees with light crops. Overly vigorous trees direct their energy into vegetative growth at the expense of fruit development. Heavy pruning and excess nitrogen will promote vigorous leafy growth and fewer fruit. Summer pruning can often achieve less regrowth than severe winter pruning.

5) Crop regulation

Thinning techniques decrease the number of fruit on the tree to optimise fruit size and quality, also reducing biennial bearing. Bitter pit is more likely to occur in an 'off' year when crop load is light and the fruit are large. Thinning on susceptible trees should be modified to achieve a slightly heavier crop than usual.

6) Variety

Variety also is a factor in the development of bitter pit. Some varieties such as Granny Smith, Braeburn and Golden Delicious are more susceptible to bitter pit than others. Most nurseries include susceptibility to bitter pit in their evaluations.

CONTROL

It is now common practice in NSW commercial orchards to apply foliar sprays of calcium during the growing season. Because calcium does not move quickly in the plant, good spray coverage is essential. Calcium is applied from November through to March in most fruit growing districts. Up to six sprays may be applied depending on the variety grown.

Calcium nitrate and calcium chloride are the most commonly used forms of calcium. Calcium nitrate is used up to early December as it also provides nitrogen nutrition. Calcium chloride is usually recommended from January to harvest, as extra nitrogen is not required. A wetting agent may be required with some calcium sprays so always check the label. Calcium can also be applied as a post harvest fruit dip.

SUMMARY

It is important to remember that bitter pit is a complex condition. Applying calcium will not solve the problem if there are physical factors that limit calcium uptake and transport. Good tree management is critical to avoid bitter pit.

- Maintain optimum vigour by careful timing of irrigation, fertilisers and pruning.
- Use crop regulation to maintain a moderate crop.
- Use nutrient testing to apply fertilisers according to the tree need.
- Conserve moisture by keeping down weed growth during dry periods.
- In varieties to be stored, ensure fruit is picked at the correct level of maturity, as immature fruit is more susceptible to developing bitter pit in storage.

NOTE: Boron deficiency can cause corky areas inside fruit that are similar in appearance to bitter pit. Boron deficiency should be investigated if symptoms develop when adequate calcium has been applied during the season, especially if fruit also develops cracks.

Further reading:

Broom, F D. *Bitter pit in Braeburn apples, fruit variability and sampling.* Hort Research, Ruakura NZ.

www.hortnet.co.nz/publications/science/fbroom1.htm

Market Diseases of Apples, Pears and Quinces: Bitter Pit. Washington State University.

http://postharvest.tfrec.wsu.edu/marketdiseases/bitterpit.html

Acknowledgements:

I would like to thank Batlow Fruit Co-operative for providing fruit for photography and Roy Menzies at NSW Agriculture for technical advice.

ISSN 0725–7759