Apple Fruit Disorders Related to Calcium Deficiency

Cork spot and bitter pit in apples, along with other calcium-deficiency physiological disorders such as lenticel breakdown and senescent breakdown cause significant economic losses.

Many factors influence fruit calcium concentration, and since it is difficult to raise fruit calcium level, growers should use all methods possible to gain the upper hand against bitter pit and other low-calcium-related disorders.

These disorders are related to low levels of calcium and sometimes high levels of nitrogen, potassium, and/or magnesium in the fruit flesh. Fruit flesh calcium content is influenced by many factors. Good horticultural management techniques that improve soil conditions, encourage uniform annual cropping, and encourage moderate tree vigor will decrease calcium-related fruit disorders.

Prevention of Cork Spot and Bitter Pit

A program to control bitter pit and corking should involve almost all cultural practices conducted in apple production, since no one practice guarantees control of the disorder below the economic injury level. An effective program should be based on the consideration of all five factors explained below, since in any specific orchard block one factor could be primarily responsible for the problem. Growers are urged to use these recommendations when the cost of control practices is less than losses from the disorders.

The five points in the program are listed as a person should think of them in the life of an orchard and not in order of effectiveness. Calcium chloride sprays, though listed last, offer many advantages over other parts of the program mainly because they can be started in June the year of harvest, while some of the other practices take years to accomplish.

Soil conditions

Poor soil conditions can contribute to low-calcium fruit. Water stress caused by either excessive or deficient soil moisture can contribute to increases in corking and bitter pit. Tiling to remove excessive moisture and irrigation to supply supplemental water should be practiced as appropriate.

Correcting low soil pH with agricultural limestone is recommended to reduce the availability of soil aluminum and manganese, thereby maximizing the size of the root system. The magnesium content of the lime should be regulated by the tree's requirement for magnesium and the total amount of lime needed. **High-magnesium (dolomitic) lime should not be used for routine soil pH correction. High-magnesium lime should be used only when a soil test indicates the need for lime and a leaf analysis indicates the need for a large amount of magnesium.**

Balanced nutrition

Soil testing to check soil pH and leaf analysis to determine the plant's uptake of essential nutrients are necessary in managing an orchard fertilization program. Avoid excessive levels of nitrogen, potassium, and magnesium and deficient levels of calcium, boron, and zinc, since these conditions may contribute to deficient fruit-calcium levels. Ratios of some elements may be indicators of potential corking and bitter pit problems. High N/Ca, K/Ca, Mg/Ca and (N+K+M)/Ca ratio in fruit peel and/or leaf samples may indicate a propensity for corking and bitter pit to show up in storage.

Although soil testing and leaf analysis are not practiced by all growers, they are universally recognized as the best methods on which to base a sensible nutritional program. These two tools will minimize wasted money on unnecessary fertilizer, prevent the application of nutrient elements already present in adequate or excessive amounts, and recommend application of only those fertilizer elements necessary to ensure a profit for the grower.

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Moderate tree vigor

Since the vegetative portions of a tree have relatively high concentrations of calcium and are seldom deficient in it, excessive tree vigor can use calcium that otherwise might be available for the fruit. Excessive pruning and nitrogen fertilization, coupled with overcrowding of trees, are often interrelated and can result in overly vigorous trees. Excessive tree vigor can also result from an inadequate fruit load. Growth regulators should be used to obtain a uniform fruit load in order to promote uniform, moderate tree vigor.

Moderate fruit density

High levels of corking and bitter pit may be found on trees with a light crop. When trees bear a light crop of apples, the fruits are normally very large and low in calcium. They are prone to low-calcium physiological disorders. Apples on trees with an excessively large crop usually have little corking and bitter pit but seldom reach optimum size to maximize profitability. Some factors to be managed for uniformity of cropping are frost protection, pollen source, bee population, and pollinating weather.

A prerequisite for achieving moderate annual fruit density is the annual production of high-vigor fruit buds. An essential ingredient in this program is the effective use of growth regulators to thin excessive crops and to encourage the production of high-vigor flower buds for the following year's crop.

Bitter pit in Honeycrisp apples can be especially difficult to control. Research has shown that crop load will impact the severity of bitter pit. In Pennsylvania, moderate crop loads of 5 to 7 fruit per square centimeter of trunk cross-sectional area reduce the incidence of bitter pit. Lower crop loads of 2 to 4 fruit tend to produce larger fruit that are more prone to exhibit bitter pit under Pennsylvania conditions. The heavier crop loads, however, require the use of NAA/ethephon return bloom sprays during the growing season to maintain annual bearing capacity.

Calcium sprays

Sprays of calcium chloride have been successful in reducing or commercially controlling corking and bitter pit, but seldom have these sprays completely eliminated the problem. Extensive research has been conducted around the world to define the products, rates, and timings that will minimize the incidence of low-calcium physiological disorders in apples. The major portion of the research has been conducted on Golden Delicious and York Imperials. However, recommendations developed from research in Pennsylvania have effectively controlled corking and bitter pitting in nearly all varieties.

The effective use of calcium chloride tree sprays may be the most cost-effective, quickest cultural practice for reducing low-calcium physiological disorders in apples. We recommend applying 15 to 50 pounds of calcium chloride per acre per season in six to eight cover sprays. Calcium in the form of calcium chloride is recommended because of its proven effectiveness and lower cost. We have developed a useful calculator for comparing calcium chloride to other sources of calcium, as it is important to make sure you develop a season-long program for applying sufficient total amounts of elemental calcium.

Other products that supply calcium are available. Many are recommended at rates that supply lower amounts. These products may be beneficial when only small amounts of calcium are needed to correct the deficiency. To evaluate other materials effectively, growers should compare the cost per pound of actual calcium and the amount of formulation needed to achieve an equivalent rate to the 15 to 50 pounds of calcium chloride per acre per season needed to control problems.

In summary, many factors influence fruit calcium concentration, and since it is difficult to raise fruit calcium level, growers should use all methods possible to gain the upper hand against corking, bitter pitting, and other low-calcium-related disorders. Cultural practices involve soil and nutritional factors as well as tree vigor and fruit density.

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