Agronomic Spotlight

Seminis
grow forward

Blossom End Rot of Pepper

- Blossom end rot of pepper is caused by a localized calcium deficiency within pepper fruit and/or environmental stress factors.
- Blossom end rot is often associated with fluctuations in soil moisture or rapid growth and rarely results from inadequate levels of calcium in the soil.
- Maintaining uniform soil moisture and preventing excessive vegetative growth can help minimize blossom end rot in pepper.

Blossom end rot (BER) of pepper is not an infectious disease caused by a biological pathogen but rather a physiological condition resulting from environmental conditions. BER often occurs following periods of fluctuating soil moisture, such as when heavy rains are followed by a dry period, followed by irrigation. The condition is most common with rapidly growing plants on early set fruit. The presence of BER symptoms on a pepper renders that fruit unmarketable and, if severe, can result in substantial yield losses.[1,2,3]

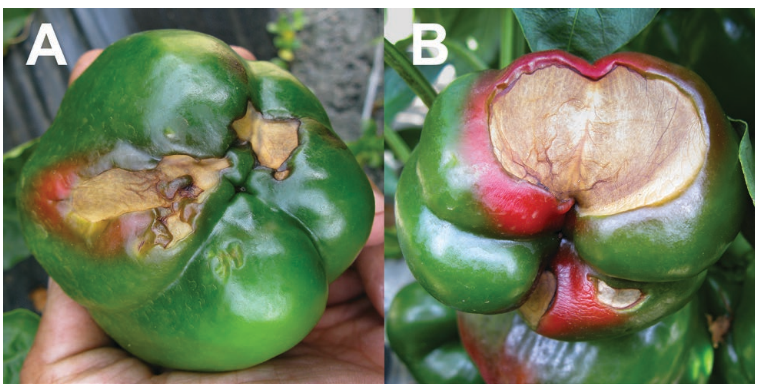

Figure 1. (A) Initial and (B) advanced symptoms of blossom end rot of pepper.

Symptoms

Symptoms of BER first appear as small, water-soaked, light-green, yellow, or brown spots at the blossom end of pepper fruit. These lesions may also appear on the sides of the fruit (Figure 1A), but usually near the blossom end. However, by the time that symptoms are noticed, the amount of damage is usually much more extensive.[1,2,4] The spots enlarge as the fruit grow, and they may eventually cover up to half of the fruit surface. The affected tissue becomes sunken, tan to brown to black, and leathery. Eventually, the tissue dries out and becomes papery and straw-colored (Figure 1B).[2,3] BER symptoms can be mistaken for sunscald. However, sunscald symptoms usually occur on the upper portion of the fruit near the stem.[4] Tissue affected by BER is frequently colonized by secondary fungal and bacterial pathogens that further rot the fruit. Fungal growth on the senescent tissue can give the affected areas a black fuzzy appearance (Figure 2).[1,2] Fruit with BER often ripen and color more quickly than healthy fruit.

Calcium and Blossom End Rot

Many studies on BER support the theory that the problem results from a localized calcium deficiency in the fruit. Calcium serves several important functions in the plant. Calcium is a component of calcium pectate, the material in cell walls that cement cells together. Calcium is needed by cells for normal cell growth and for nutrient uptake. When plants are deficient in calcium growing tissues, cells start leaking and the tissue starts to break down and the cells die.[1,4] The symptoms of BER on peppers are thought to be the result of insufficient levels of calcium in the tip of the fruit, where the cells are multiplying and expanding.

Plants obtain calcium from the soil solution, which contains calcium ions. Unlike some other nutrients, calcium is not actively taken up by the roots. Rather, it moves passively with the soil water into the xylem, and it is carried up through the plant through the processes of transpiration and root pressure. During transpiration, water is released from the leaves, stems, and fruit. Leaves are the primary drivers of transpiration, so most of the water, and thus calcium, move from the roots up into the leaves. Root pressure is the main method by which water moves through the plant at night when humidity levels are high, as transpiration from the leaves is reduced. Water movement through root pressure requires adequate amounts of soil moisture. Conditions that reduce water movement in the plant, such as low soil moisture, closing of stomata, and cool, cloudy days, also reduce the movement of calcium within the plant. Young leaves have the greatest density of stomata and a thin waxy cuticle layer, while fruit have fewer stomata and a thicker waxy cuticle, which is why water transpires more rapidly from leaves than it does from fruit and why calcium is transported preferentially to the leaves. [1,2,3]

Figure 2. Colonies of a secondary fungal pathogen growing on a blossom end rot lesion.

It is thought that problems with BER arise when the need for calcium in developing fruit is greater than the amount that the plant can supply. The lack of adequate calcium levels in the fruit is most often

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the result of movement of calcium within the plant rather than a deficiency of calcium in the soil. There can be an abundance of calcium in the soil and plenty of calcium in other parts of the plant, including the stem end of the fruit, when BER occurs. BER is often most severe when fruits are just starting to form early in the season, the crown fruit. At that time, the ratio of leaf vs. fruit surface area is the greatest, and calcium is being transported primarily to the leaves.[1,3] However, BER can occur on expanding fruit at any time during the fruit production period.

There is some evidence that the lack of calcium is a result, not a cause of BER.[5] This reseach indicates that BER is caused by other kinds of plant stress. More research is needed to verify the cause or causes of BER.[6]

Factors Affecting Blossom End Rot

The two main factors that affect the development of BER are soil moisture levels and the vegetative growth rate of the plant. Fluctuating soil moisture levels affect the rate and amount of calcium reaching the fruit, and poor irrigation management can increase BER levels. Excessive nitrogen fertilization stimulates vegetative growth, which can lead to increased BER.

Other factors can also contribute to BER problems. High levels of other nutrients/ions, including nitrogen (N), phosphorus (P), magnesium (Mg), potassium (K), sodium (Na), and ammonium (NH_4) can reduce the concentrations of calcium (Ca) taken up by the roots.[1,3,4] Loss of active root tissue resulting from mechanical root pruning, root diseases, or flooding also reduces the amount of calcium absorption by the roots. Weather factors, such as temperature and humidity, affect plant growth rate and transpiration, thus affecting the transportation of calcium within the plant.[1,2] Pepper fruit in the rapid expansion phase (one-third to one-half of full size) are particularly susceptible to BER as they have the greatest need for adequate levels of calcium.[3]

BER rarely results from inadequate levels of calcium in the soil solution. Most soils in which vegetables are commercially produced have adequate calcium levels and receive regular applications of fertilizers containing calcium. Soils containing high levels of calcium carbonate (limestone) have adequate levels of available calcium in the soil solution, and well water used for irrigation is often a source of calcium.[1]

Managing Blossom End Rot

BER is best managed by minimizing the conditions that favor the development of the problem. Proper soil moisture management is usually the most effective method for preventing BER. In particular, ensure an adequate water supply during high-stress periods (dry conditions) and when fruits are most susceptible. Irrigate plants to avoid moisture stress and minimize soil moisture fluctuations. Provide uniform moisture both during the day and at night, especially during the fruit set and growth periods. Irrigation schedules and amounts should be adjusted based on rainfall to avoid overwatering. The use of plastic or organic mulches can help maintain uniform soil moisture levels. Some plastic mulches can warm the soil in the spring, increasing root activity and calcium uptake, while silver or white-on-black mulches can help moderate temperatures in the summer and fall, lowering plant stress.[1]

Provide balanced fertility to prevent excessive vegetative growth. Ammonium (NH_4) forms of nitrogen compete with calcium for root uptake, so applying nitrate (NO_3) forms of nitrogen are less likely to increase levels of BER. Avoid applying side dress fertilizer during the onset of fruit set and development.[1,4] Plant into a well-prepared soil bed, and eliminate compaction zones that inhibit root growth. Minimize factors that damage roots or inhibit root activity, such as diseases, nematodes, flooding, and mechanical root damage.

Growers should use soil and water testing to determine the levels of calcium in their soils and irrigation water. Calcium fertilizers should only be applied to address problems with blossom end rot if soil testing indicates a calcium deficiency. In soils with pH levels below 6.5 and high magnesium concentrations, applying lime to the soil can help increase the level of plant-available calcium.[1,3]

Soil applications of calcium fertilizers usually have no impact on the BER severity because the problem is caused by the movement and distribution of calcium within the plant, not the availability of calcium in the soil. Foliar applications of calcium are also not likely to help reduce or prevent blossom end rot. Calcium is not absorbed well through the leaves, and it does not move from the leaves into the fruit.[1,3,4] Sometimes, growers think that a foliar application helps control blossom end rot because the severity of the problem declines after an application. More likely, that decline is associated with slowing plant growth later in the season, changes in weather, and changes in irrigation or other aspects affecting soil moisture.[2]

Sources:

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