



## Blossom-End Rot of Tomato in Hawai'i

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Tomato fruits (*Lycopersicon esculentum*) are high-value crops in Hawai'i for commercial production. In 2007, the total value of sales of fresh tomato in Hawai'i was US\$9.8 million (Statistics of Hawai'i Agriculture 2009). Tomato is also widely grown by home gardeners, who use the harvested fruits in salads and other recipes. Cultivation of tomato presents a suite of challenges that include a large number of insect pests and plant diseases caused by nematodes, bacteria, fungi, and viruses. In addition to these pathogenic diseases, under-fertilized tomato crops can also suffer from nutrient deficiencies (Ebesu 2004). Here we discuss the symptoms and management practices for one of the most common and easily recognizable nutrient-deficiency diseases of tomato in Hawai'i—blossom-end rot (BER), caused by a lack of the element calcium in tomato plants.

### Disease

Blossom-end rot is a common, preventable abiotic disease that can occur on tomato and many other fruiting plant species. Although the affected fruits are safe for human consumption, the disease can cause significant yield losses and produce unmarketable fruit.

### Causes

Blossom-end rot is attributable to a localized calcium deficiency in the tomato fruit (Valenzuela et al. 1993). Calcium performs several functions relating to plant growth and health, among them maintenance of cell wall rigidity and regulation of cell activity (Patterson 2007). As an immobile nutrient, calcium is not easily trans-

ported from roots to the growing points in plants. For this reason, a calcium deficiency will become apparent first in the youngest growth, in this case the immature fruits.

Blossom-end rot of tomato can also present itself in the presence of a sufficient calcium supply, under certain environmental conditions such as an interrupted or reduced water supply, or drought, during hot weather. Factors which negatively impact the supply and uptake of water—and with it, calcium—during fruiting can increase a plant's susceptibility to blossom-end rot. Some of these factors include irregular soil moisture levels, high population density, excessive salt concentrations,



Circular areas of brown to black necrosis appear at the blossom end of tomato fruits when there is a significant deficiency in calcium.

lack of aeration in the root zone, presence of other plant diseases, and general plant stress (Miller et al. 1996).

Over-fertilization is another possible cause of blossom-end rot, especially with fertilizers high in nitrogen, which induce plant growth rates that exceed the supply or mobility of calcium within the plant.

### Symptoms

Symptoms of blossom-end rot typically occur when the fruit has reached a third to a half of its mature size (Sherf and Woods 1979). As the disease name implies, the symptoms appear only on the blossom end of the tomato fruit. The rot first appears as a small, brown, water-soaked spot at the tip of the blossom end, a result of inadequate calcium for the maintenance of cell wall rigidity and proper cell activity. The spot may quickly enlarge and darken as the fruit continues to develop and can ultimately cover up to half of the entire fruit surface. The lesion may become flattened, dry, and leathery to the touch. Immature fruit ripening can often result.

### Management

**Supplementation.** As a preventative measure, soil testing is recommended to ascertain the existing nutrient concentrations and determine if there is a shortage of plant-available calcium. Liming with dolomitic or high-calcium limestone several months prior to planting can reduce BER susceptibility in calcium-deficient soils (Jones et al. 1997). During plant growth, proper fertilization and regulated irrigation will greatly reduce the risk of blossom-end rot. Mulching can help minimize fluctuations in soil moisture. If calcium levels are a concern after planting, plant tissue can be submitted for testing. The recommended plant tissue calcium concentration for tomato in Hawai'i is 1.40–2.20% (Silva and Uchida 2000). While there is no treatment for fruits that have already been affected, regular foliar sprays of anhydrous calcium can help to alleviate BER for developing tomato fruits. Foliar spraying is recommended only in emergency situations, as it is not a suitable replacement for maintaining soil nutrient levels. Additionally, calcium chloride can be phytotoxic at high concentrations (Sherf and Woods 1979).

**Variety selection.** There are currently no tomato cultivars with proven resistance to blossom-end rot;



**Blossom-end rot is often mistaken for an infectious disease, but it is not. Symptoms often appear on green, unripe fruits. The dried flower blossom can still be seen at the end of this immature fruit.**

however, plants that are more tolerant of local conditions in Hawai'i may be less susceptible to calcium deficiency. When selecting a tomato variety, growers should consider where it was bred and developed, as most tomato varieties grown in Hawai'i were developed outside of the state. Growers in Hawai'i often believe that if they select a tomato variety from an area with a climate similar to Hawai'i's, it will perform well in Hawai'i. For instance, some locally popular tomato varieties were bred and developed in large commercial tomato farms in southern Florida, where the climate is very close to Hawai'i's. Climate, however, is not the only factor to keep in mind. Some areas of south Florida have calcareous soils, which usually means that tomato varieties developed there have higher calcium demands than those developed in regions with non-calcareous soils. Tomato varieties that require higher levels of calcium are more susceptible to blossom-end rot when grown in less calcium-rich soils. Therefore, growers should expect that the calcium requirements of tomato varieties will differ, and they may want to select varieties that were bred and developed in areas with non-calcareous soils. Contact the Cooperative Extension Service for specific recommendations regarding tomato varieties for cultivation in your area.

**Hydroponic cultivation systems.** For tomatoes grown hydroponically, blossom-end rot can develop when young fruits develop and expand during certain weather conditions (hot, dry air) that create a demand for uptake and movement of calcified irrigation water in the growing plants. Therefore, in hydroponic settings, special attention must be paid to regulated water availability (always providing enough water), adequate root aeration, and proper fertilization (McCall and Nakagawa 1970).

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