



Cercospora Leaf Spot of Eggplant

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Eggplant (*Solanum melongena*) is a warm-season vegetable cultivated worldwide for its fleshy fruit. The name is believed to reflect the early forms of the fruits, which were small, white, and resembled eggs (Hui 2006). The plant belongs to the genus *Solanum* within the family Solanaceae. Varieties are grown both as perennial and annual crops. The typical plant has a spiny stem bearing broad leaves and white to purple flowers. The fruits are generally dark purple in color and have a wide range of shapes and sizes. The eggplant is believed to be native to India, where it has long been cultivated (Gastier 2000). It is widely used in China, India, Japan, and many Mediterranean countries (Hui 2006). Eggplant was introduced to American gardeners in 1806 and to Hawai'i in 1824 (Staples and Herbst 2005). Initially, the plants were grown as ornamentals by gardeners, but later, with the development of less bitter-tasting varieties, the fruit was accepted widely as an edible vegetable.

Eggplant has many properties that make it an integral part of a healthy diet. It is a rich source of dietary fiber, vitamins, potassium, and calcium; it also has low fat, zero cholesterol, and a very low calorie content. Therefore, eggplant is a preferred food among weight-conscious consumers. It can be boiled, stir-fried, deep-fried, steamed, roasted, or baked. Eggplant is a vital element in



Cercospora leaf spot on eggplant growing in Mānoa Valley, O'ahu, Hawai'i

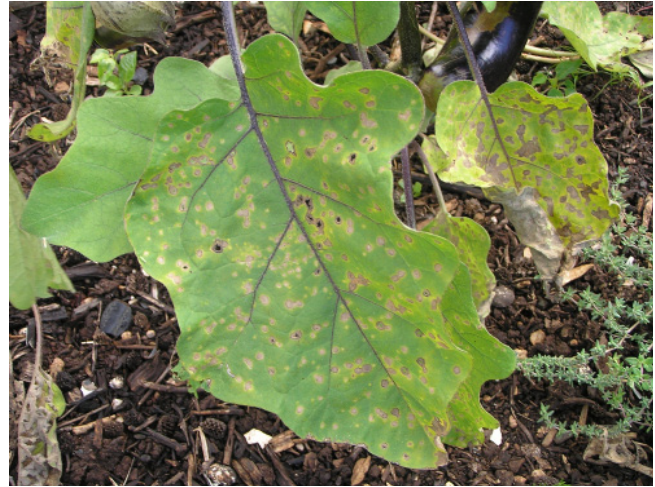
many globally renowned dishes such as the French ratatouille, the Italian melanzane alla parmigiana, and the Middle Eastern baba ghanuj. In Indian cuisines, eggplant is used in a variety of ways ranging from curries to chutneys. Baigun bhurta is the most popular eggplant dish of India. Aside from being used as food, eggplant is also used in medicines in China, Southeast Asia, and the Philippines (TNAU Agritech Portal 2008). China is the leading producer of eggplant in the world, contributing around 55% of the world's output. Other major producers are India (28% of the world's production), Egypt, Turkey, and Japan (Raabe et al. 1981).

In Hawai'i, eggplant is an important crop grown by farmers and home gardeners. Three distinct varieties are cultivated for food, while others are grown as ornamental plants. Fruit of the Japanese-type eggplant, which is mostly preferred by Asian cooks, is elongated and dark purple colored. The Italian-type eggplant fruit, also dark purple, is large and oval-shaped, and the Thai-type fruit, which is smaller and rounder, is green to white (Staples and Herbst 2005). According to Hawai'i Agriculture Statistics data, eggplant was grown on over 70 acres of land in 2009 and had an economic value of US\$1.2 million (USDA, National Agriculture Statistics Service 2011).

More than 10 genera of plant-pathogenic fungi infect



In a typical garden plot in Hawai'i, eggplant is one of many different plants. It is often grown in congested conditions within a confined space. This creates the high relative humidity that favors infection of eggplant leaves by *Cercospora melongenae*.



The centers of lesions may fall out, creating a shot-hole appearance. Adjacent lesions may coalesce to form areas of blighted tissue.

eggplant in Hawai'i (Hawai'i Host-Pathogen Database 2012), some of them causing severe diseases. One of the most common fungal diseases of eggplant in home and community gardens is *Cercospora* leaf spot. This disease weakens plants and reduces yields by causing the premature defoliation of infected leaves. In this article we discuss the pathogen and disease symptoms and suggest integrated management practices that can help gardeners realize better plant growth and higher yields.

Pathogen and Disease

A plant-pathogenic fungus, *Cercospora melongenae*, causes *Cercospora* leaf spot of eggplant in Hawai'i. The genus *Cercospora* is a hyphomycete fungus comprised of many plant-pathogenic species. They produce leaf spot diseases on a wide range of agriculturally important plants. These diseases are major problems for large-scale growers and backyard gardeners (Chupp 1953; Farr 1989; Kranz and Werner 1978; TNAU Agritech Portal 1989; Gonsalves et al. 1994). There are about 1,200 known species in the genus *Cercospora*, with over 69 species reported in Hawai'i (Raabe et al. 1981).

Cercospora melongenae can survive for at least one year in plant debris or in soil. The disease process begins when the fungal spores are dispersed to susceptible plants by rain, irrigation water, or wind, or on agriculture

equipment or by people (Nelson 2008). Leaf wetness and high relative humidity favor infection and disease development. Symptoms appear on the older, lowest leaves first, and if unchecked can move upwards and infect young leaves and stems. Severely infected leaves curl and prematurely drop off the plant, often causing a reduction in yield (Chupp 2006). The pathogen does not infect eggplant fruits but does reduce the growth of plants and thus reduce yield. Where the disease is severe, it can be fatal to plants.

Symptoms appear on the leaves, petioles, and stems of eggplant. Initially, small, circular to oval chlorotic spots appear that may develop angular or irregular shapes. The spots on leaves can easily be confused with spots caused by a bacterial disease. On closer inspection, however, the spots due to *Cercospora* show distinguishing features. They are generally circular with light to dark tan centers, and the stomata have black spots that can be readily observed using a hand-held magnifying lens. Elliptical to oval lesions may occur on the leaf blades, veins, and petioles. Bacterial leaf spots, conversely, are irregularly shaped or circular spots with clear stomata (Windels et al. 2003).

The leaf spots on eggplant caused by *C. melongenae* are 4–10 mm in diameter and visible on both leaf surfaces, though they may appear more abundantly on the



Lesions tend to appear first on older leaves.



Infected leaves eventually turn yellow, curl up, and fall from the plant prematurely.

lower surface. They are brown to steel-gray on the upper surface and light brown on the lower surface (Anonymous 2011). Conidiophores (fungal structures that bear the spores/conidia) appear in fascicles (clusters) of 3 to 12. They are pale to medium brown, paler towards the apex, occasionally septate, and unbranched, and they bear hyaline, mildly curved conidia (Mycobank Database 2012). During the later stages of disease, lesions become grayish brown, with excessive sporulation at their centers. Concentric rings of diseased tissue may appear as the lesions gradually expand in size. As a lesion dries, the tissue in the center may crack and drop out.

Disease Management

Both organic and inorganic approaches can be used for the management of this disease.

- Maintain proper field sanitation: Collect and bury infected crop residues; remove and destroy severely diseased leaves.
- Use disease-free transplants.
- Control weeds to reduce relative humidity in the

eggplant canopy.

- Irrigate in the morning to reduce humid and damp conditions overnight.
- Avoid over-irrigation to reduce relative humidity.
- Avoid overhead sprinkler irrigation in order to minimize leaf wetness and spread of the pathogen in splashing water droplets.
- Do not work with wet plants or move through a field of wet plants, as such movement can disperse fungal spores among plants.
- Increase the spacing between plants to improve aeration and drying of wet foliage.
- Keep plants adequately fertilized.
- Intercrop eggplant with other vegetables to interrupt pathogen transmission between plants.
- Grow eggplant under cover (i.e., in greenhouses or under shade cloth) where possible to minimize leaf wetness.
- A calendar-based spray program using a protectant fungicide, combined with cultural practices, can reduce losses from *Cercospora* leaf spot on eggplant.

Table 1. Some fungicides registered in Hawai'i for controlling *Cercospora* leaf spot disease of eggplant (Source: Hawai'i Pesticide Information Retrieval System)

Product Name	Active Ingredient(s) (Percent)	Formulation
Bravo Ultrex® Agricultural Fungicide	Chlorothalonil (82.5%)	Water-dispersible granules
Bravo Weather Stik® Agricultural Fungicide	Chlorothalonil (54%)	Emulsifiable concentrate
Bonide Liquid Copper Fungicide Concentrate	Octanoic acid, copper salt (10%)	Flowable concentrate
Bonide Liquid Copper Fungicide Ready to Use	Octanoic acid, copper salt (.08%)	Solution – ready to use
Bonide Neem Oil Fungicide · Miticide · Insecticide Concentrate	Clarified hydrophobic neem oil (70%)	Oils – no added pesticide
Garden Safe® Brand Neem Oil Extract Concentrate	Clarified hydrophobic neem oil (70%)	Oils – no added pesticide
Natural Guard® Neem	Clarified hydrophobic neem oil (70%)	Oils – no added pesticide
Natural Guard® Copper Soap Liquid Fungicide	Octanoic acid, copper salt (10%)	Flowable concentrate
Serenade® Garden Disease Control Concentrate	QST 713 strain of <i>Bacillus subtilis</i> (1.34%)	Emulsifiable concentrate
Serenade® Garden Disease Control Ready to Spray	QST 713 strain of <i>Bacillus subtilis</i> (1.34%)	Emulsifiable concentrate

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