Bacterial Angular Leaf Spot of Strawberry

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Bacterium causing the disease: *Xanthomonas fragariae* (Kennedy & King)

Introduction - Of the three bacteria identified as causing or contributing to disease in strawberry, bacterial angular leaf spot is the most common found in commercial fruit production operations. Cauliflower disease, caused by *Cornyebacterium fascians*, and vectored by nematodes, has not occurred in North America. Bacterial wilt, caused by *Pseudomonas solanacearum*, occurs in nursery seedlings but is rare in mature field grown plants.

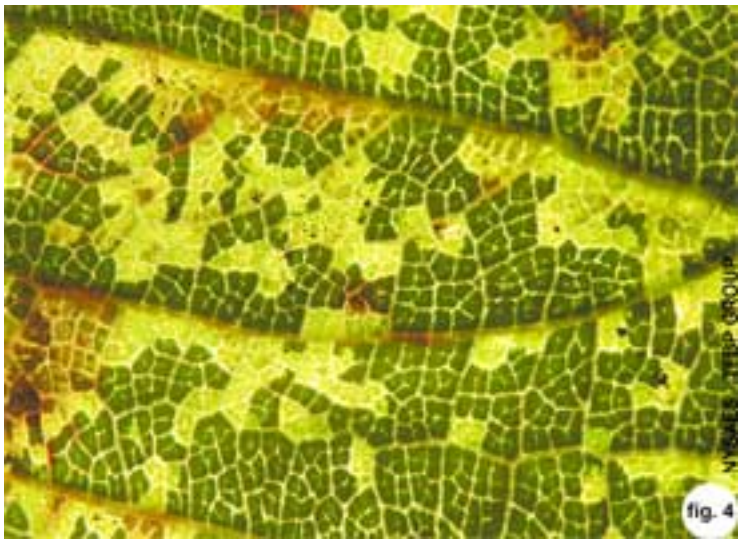
Bacterial angular leaf spot was first reported in Minnesota in 1960, and appears to have originated in the United States. The disease, while not fully understood, is a potentially devastating disease of strawberry. More research is needed on the epidemiology, control and economic importance of the disease in fruit and nursery production systems.

Angular leaf spot on the underside (abaxial)(Fig.1) and topside (adaxial)(Fig.2) of strawberry leaves.

Symptoms

Leaves: Angular leaf spot appears first as tiny water-soaked spots (lesions) on the lower leaf

surface. These enlarge to form angular lesions, restricted by small leaf veins (Fig. 1). The young spots are usually best viewed on the underside of the leaf and appear translucent when looked at with a light source behind them (Fig. 4), and dark green when viewed normally (Fig. 3). This difference is an important distinguishing characteristic in identifying the disease. Lesions eventually become visible on the upper leaf surface, and appear as irregular, reddish brown spots, which may become necrotic (dead)(Fig. 2). Spots on the upper surface may grow together to cover large leaf areas, causing infected leaves to appear scorched or blighted (Fig. 5). At this point, symptoms closely resemble those of leaf spot, caused by *Mycosphaerella fragariae* and leaf scorch, caused by *Diplocarpon earliana*. The necrotic tissue becomes dry and brittle, breaking off, giving leaves a frayed or ragged look. (Fig. 1B,1C) Heavily infected leaves may die if the bacterial infection moves into major veins.



Underside of strawberry leaf viewed with top lighting (healthy = Light Green, infected = Dark Green)(Fig. 3). Underside of strawberry leaf viewed with back lighting (healthy = Dark Green, infected = Light Green to Transparent)(Fig.4).

Coalescence of angular leaf spots and scorching on strawberry leaves (Fig. 5).

Leaf stems (petiols) and Crown: Systemic infections may occur, with all types of vascular tissue or the crown being infected. In severe cases, a vascular decline similar to that caused by *Phytophthora cactorum* or anthracnose crown rot may develop. Water soaking at the base of newly emerging leaves may be the only visible symptoms to be expressed before the plant suddenly dies. The bacterium may be isolated from roots, crowns, petioles, stolons, and daughter plants.

Fruit: When infections of *X. fragariae* become systemic, the berry cap (calyx) may also be infected. The modified leaves of the berry cap (sepals) darken and dry. This reduces the marketability of the fruit significantly in some instances.

Signs (visible presence of the pathogen) - When moist conditions are present, the undersides of infected leaves will have a viscous bacterial exudate. This dries to form a whitish scaly film. This scaly exudate is also important in identifying the disease.

Disease Cycle - Inoculum for primary spring infections in new growth comes primarily from infected transplants or systemically infected overwintered plants and dead leaves. This bacterium is resistant to adverse conditions such as dessication, and can survive for long periods in dry leaf debris or buried leaves in soil. Bacteria exuded from the undersides of leaves under high moisture conditions serve as the secondary source of inoculum in plantings. Angular leaf spot bacteria are carried from plant to plant by splashing water from rain or overhead irrigation, as well as harvesting operations.The motile bacterial cells may enter the plant through drops of dew, guttation droplets, rain or irrigation water.

Conditions Favoring Infection - Not much is known in this respect, and more research is underway to determine which conditions are most favorable for disease development and spread. Some report moderate to low daytime temperatures and might time temperature below freezing are needed. Most researchers agree high humidity is also a key factor.

Control Measures - Dissemination in transplant materials has been shown to be the most significant route of establishment and movement of strawberry angular leaf spot. Prevention of angular leaf spot starts in the nursery. Plant only disease free plants purchased from reliable nurseries (Appendix of Strawberry Cultivar Disease Resistance). Select planting sites with light, well drained soil, good air circulation and exposure. Apply nitrogen fertilizers only at renovation to reduce succulent new leaf tissue which is more susceptible. Carefully space

runner plants in matted-row culture and control weeds in all plantings to improve air circulation and reduce drying time for leaves. Avoid use of overhead irrigation. Remove older or infected leaves before setting runners in new plantings. Removing and burning all debris at renovation (after harvest) helps to reduce overwintering inoculum of the bacterium, as it does not survive alone in soil. If angular leaf spot becomes a problem in the planting, apply copper pesticides at the label recommended rates for control aid in control. Thoroughly cover all above ground plant parts with spray, especially undersides of leaves, as this is where bacterial inoculum forms and is dispersed. For more information on control programs see "Pest Management Guidelines for Commercial Small Fruit Production" . Check product labels for timing and rates of application for products. Note: Phytotoxicity has been reported with 6-7 successive copper applications.

Reference List

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