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Bacterial Angular Leaf Spot

Angular Leaf Spot disease of strawberry, caused by the bacterium *Xanthomonas fragariae*, is often confused with common leaf spot and leaf scorch diseases. Once infection is established, little can be done until the wet cool conditions subside.

Bacterial Angular Leaf Spot (*Xanthomonas fragariae*)

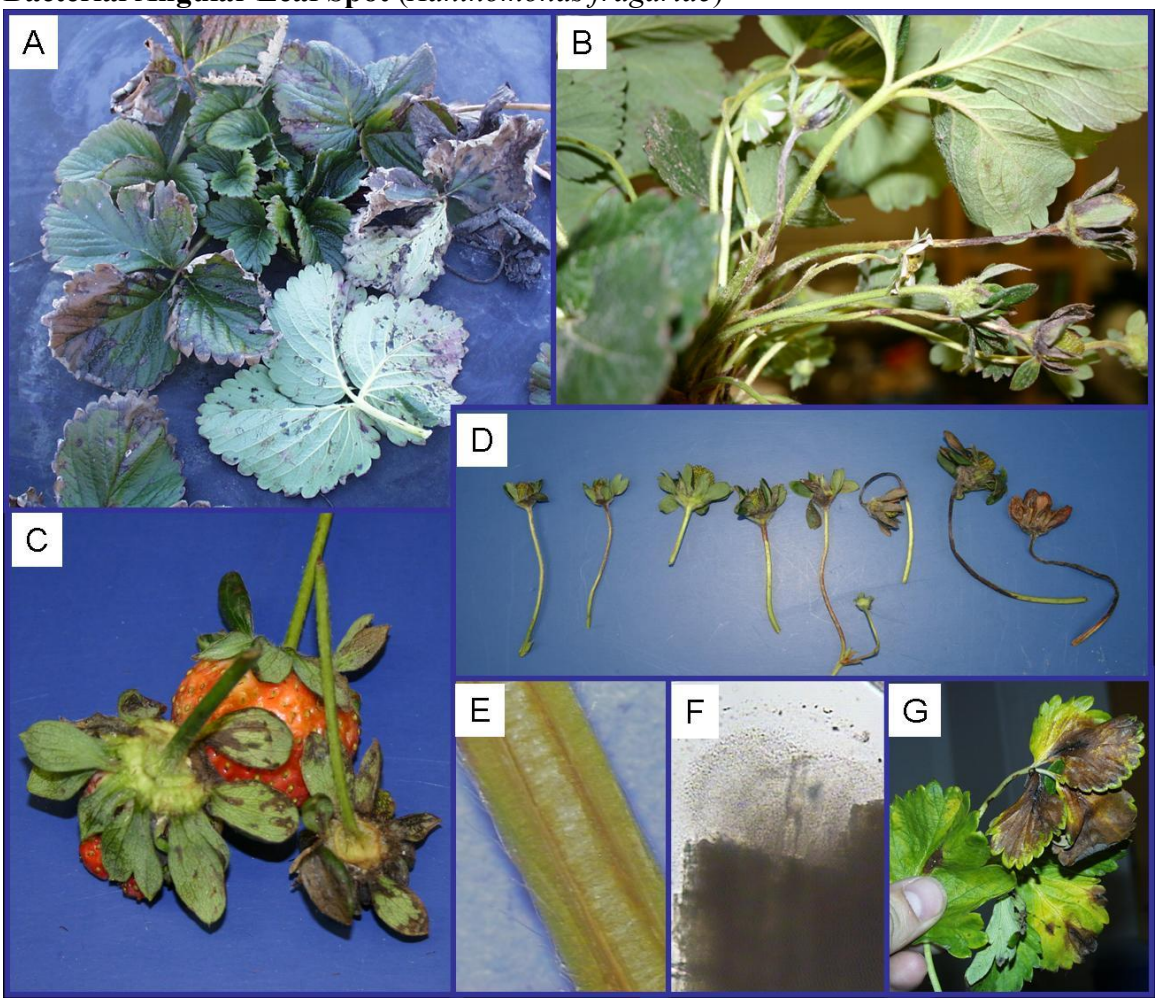

Figure: A) Plant severely infected by *Xanthomonas fragariae* and overturned leaf showing angular leaf spots between veins where bacteria have colonized the tissue; B) A flower truss with symptoms of black discoloration on the calyx and peduncle; C) Angular lesions on the calyx of developing fruit; D) range of symptoms on the calyx and peduncles; E) brown discoloration in the xylem tissue due to systemic infection by the bacteria; F) Bacterial ooze from infected strawberry tissue that serves as a positive diagnosis for angular leaf spot (100x); G) Leaf showing a blight symptom associated with systemic infection by *X. fragariae*.

Symptoms and Signs

Water-soaked lesions first appear on the lower surface of the leaf, becoming angular as they enlarge and usually delineated by veins (Figure A). When conditions are very moist, lesions may exude a viscous yellow substance that is actually a mass of bacteria. Upon drying, a

characteristic white film is left on the leaf surface. In time, lesions will also be visible on the upper leaf surface as irregular, reddish brown spots that may be surrounded by a yellow halo. These symptoms are difficult to distinguish from common leaf spot and leaf scorch. One identifying characteristic is the translucent nature of lesions when leaves are held up to a bright light; looking from the backside, light will pass through the angular lesions. Entire leaves and major veins may become infected, giving the leaves a ragged appearance (Figure G). Berry caps may become infected, darkened, have angular lesions and are unappealing (Figure C). Vascular infection and wilting by *X. fragariae* may lead to plant death, but this is not as common as leaf spot. This systemic infection may be confused with wilt of anthracnose or Phytophthora crown rot; however, crown tissue infected by *X. fragariae* does not become discolored. Infected material will typically ooze bacterial cells when dissected and viewed under a compound microscope (Figure F).

Disease Cycle

X. fragariae primarily enters the field via infected planting stock, and may persist in the field by overwintering or oversummering in infected plants and dead leaves. In the Southeast, problems have not persisted from one year to the next in annual plantings due to soil inoculum. The pathogen cannot survive freely in the soil, but can survive on transplants in cold storage for one year and on plant debris through long dry periods. Bacteria become active and are splash-dispersed to healthy leaves in wet weather or with irrigation water. *X. fragariae* favors low day (60F) and night temperatures (near freezing) and high relative humidity. Favorable conditions for disease development occur during transplant establishment and when frost protecting. Cool wet weather during flowering and fruit formation can cause loss of fruit (figure B & D) or lead to a discolored calyx – rendering the fruit unmarketable. Healthy plant tissues are more likely to become diseased than stressed tissues. In most cases, yield losses due to angular leaf spot are not common but may occur when severe systemic infection occurs. Losses can be substantial if a large portion of the fruit calyxes are infected and unsightly.

Control

1. SITE SELECTON

   Choose a site with good air circulation and sun exposure to promote drying of foliage.

2. USE DISEASE-FREE PLANTS

   Use certified plant material. Be aware that infected transplants may not exhibit signs of infection until exposed to a more favorable climate, such as exists in the southern states. Resistance to angular leaf spot exists in some genotypes, yet no commercially desirable cultivars contain high levels of resistance, especially for annual production systems.

3. MONITOR AND MANAGE

   Control weeds to allow air to circulate freely around plants. Remove infected leaf debris by hand, raking or vacuuming. DO NOT remove infected debris if anthracnose is suspected to be present. Avoid using overhead irrigation if possible. Under serious disease conditions, ensure all strawberry debris is soil incorporated to optimize tissue break down. Rotation is not essential. A change in weather patterns from cool and wet to warm and drier results in disease decline.

4. CHEMICAL CONTROL

No bactericides are labeled for use nationally against angular leaf spot. Early application of registered copper materials prior to rapid growth may reduce disease, but fungicides are not very effective in managing angular leaf spot because the bacteria can reside within the plant tissue.

Caution should be taken when using copper fungicides because accumulations can be phytotoxic. Angular (bacterial) leaf spot can be a serious problem during cool, wet conditions. Registered copper compounds provide some control of the peduncle and calyx infections. In fields with a known problem, apply copper fungicides when flowers and fruit are present and when cool wet weather is predicted. Repeat applications at 7 to 10 day intervals. Discontinue when phytotoxicity appears, usually after 4-5 applications.