Black Leaf Streak Disease

Pests and Diseases of American Samoa

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Black leaf streak (BLS), or "black Sigatoka", is the most damaging leaf disease of bananas worldwide. Most areas of the tropics and subtropics are affected, with reported losses of 30-50%. The first account of BLS in the Pacific was 40 years ago in the Sigatoka Valley, Fiji.

Most fungicide use in American Samoa is for control of BLS. The Cavendish-type 'Williams' banana, grown by all commercial growers in American Samoa, is very susceptible to the fungus that causes this disease. Infected plants have fewer leaves, which leads to fewer and smaller fruits, a delayed harvest, premature ripening, and lower quality fruit (Fig. 1).

Figure 1. Severe damage to the 'Williams' cultivar decreases photosynthesis.

Life Cycle and Epidemiology

There are two forms of the BLS fungus, *Mycosphaerella fijiensis* and *Pseudocercospora fijiensis*, but the former is most responsible for disease spread within and between farms. Spores of *M. fijiensis* are released from the upper leaf surface by rain, high humidity, or free water. They travel by air currents or rain splash and land on the underside of the emerging heart leaf as it unrolls. The spores germinate and germ tubes enter the leaf through open stomates. The fungus grows within the leaf, killing plant cells, before returning to the surface to produce more spores. Spores of *M. fijiensis* are produced in dead, gray tissue on the upper leaf surface (Fig. 2). Optimum temperatures for fungal growth and germination are 75-80°F.

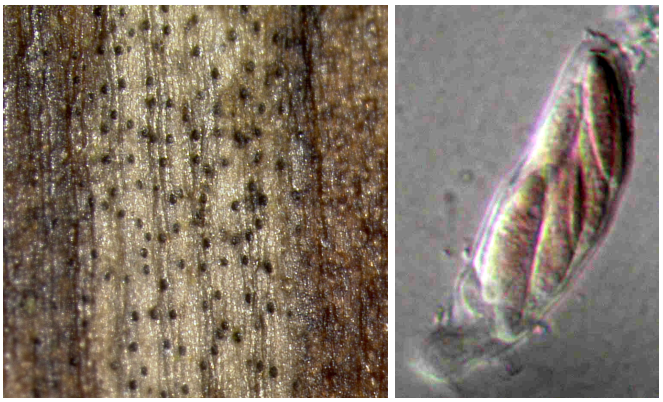

Figure 2. Spore formation of *Mycosphaerella fijiensis* on upper leaf surface (left). Black spots contain asci, or sacs, each containing eight spores (right).

Symptoms

The first apparent symptoms of leaf infection are short, reddish-brown lines about 2 mm long. The lines turn into brown streaks 20-30 mm long (Fig. 3a) which broaden into elliptical spots (Fig. 3b), brown on the underside of the leaf, black on the upper surface. The spots are slightly sunken and surrounded by a yellowish halo. Next, the center of the large spot becomes gray, bordered by a black line and yellow halo (Fig. 3c). Finally, the spots merge, killing the leaf (Fig. 3d).

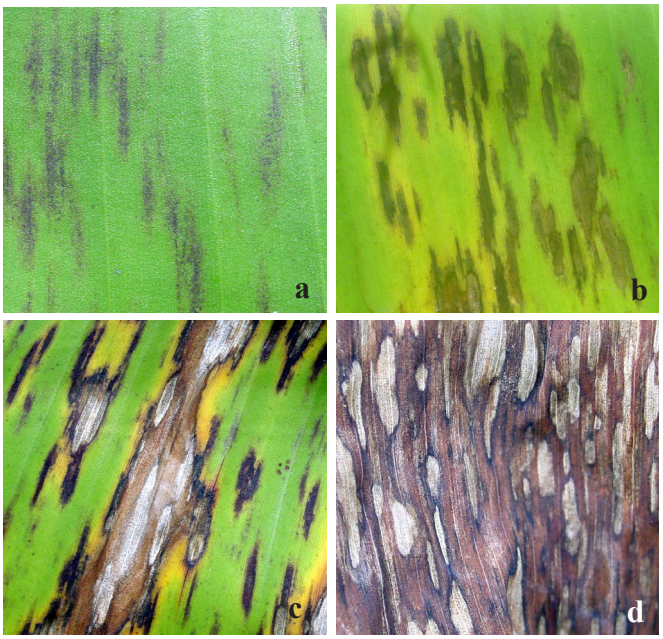

Figure 3. Symptom development: (a) late streak stage, (b) early spot stage, (c) spots with dead gray centers, and (d) dead leaf covered with spots.

Control of Black Leaf Streak Disease

Integrated Pest Management (IPM) is the modern approach to pest control. It makes use of all appropriate information and techniques to control plant disease. IPM includes: knowledge of local environmental conditions and the pest or disease cycle; physical, cultural, biological and chemical control methods; resistant varieties; and available materials, labor, and costs.

CULTURAL CONTROL

- *Deleafing*, cutting off the diseased portion of leaves, reduces the number of spores in the plantation. If more than 50% of the leaf is diseased, the whole leaf is removed. This method is labor-intensive and only effective in mild infections, or together with other control methods.
- *De-suckering* is the removal of excess plants from the rhizome (mat); most growers recommend 3-4 plants per rhizome. This concentrates more plant energy on leaf and fruit production. It also opens the canopy, decreasing moisture and humidity, and allowing fungicide spray to reach the heart leaf.
- *Sanitation*, either removing and burning infected leaves, or turning them topside-down, can reduce BLS by decreasing the number of spores available to spread the disease.
- *Plant health* and maximum leaf production can be improved by using mulch, high potassium fertilizer (e.g. 19-19-40), and by controlling other pests and diseases.

RESISTANT VARIETIES

International breeding programs have developed Cavendish-type plants resistant to BLS. Several cultivars from the Honduran Foundation of Agricultural Research (FHIA) have been evaluated by growers in American Samoa. The cultivars produce very large bunches without using fungicides.

FHIA-01 ('Goldfinger') is unpopular in American Samoa, as eating quality is inferior to 'Williams'. A limited number of FHIA-25 have been planted, however, and scored well in a Land Grant Station taste test against 'Williams' (Fig. 4).

Several FHIA cultivars are being multiplied in the Land Grant tissue culture laboratory for distribution to growers. The goal is to decrease fungicide use in American Samoa through introduction of BLS-resistant banana cultivars.

Figure 4. The BLS-resistant FHIA-25, needs no fungicide application to produce these large bunches.

CHEMICAL CONTROL

As long as commercial banana production is based on susceptible cultivars, fungicides will be necessary. Current drawbacks to chemical control include possible damage to the environment and human health, development of fungicide resistance by the pathogen, and cost.

Two types of fungicides are used to control BLS.

- *Protectants*. These chemicals remain on the surface of the leaf and inhibit spore germination or entry of the fungus into the plant. Their effectiveness depends on how well leaf surfaces are covered by the chemical and whether they are washed off by heavy rains. Protectant fungicides include:

Copper hydroxide
Dithane-M45 (mancozeb)
Manex (maneb)
Banana misting oil

- *Systemics*. This group of chemicals penetrates the leaf surface and inhibts the fungus from inside the plant. They are more effective than protectants for two reasons. First, systemic fungicides move within the plant, so coverage does not have to be as complete as with the protectants. Second, they are not washed off or diluted by heavy rain. The BLS fungus has the ability to change genetically, however, and if a systemic is used too often it may to lose effectiveness. Systemic fungicides include:

Elite (tebuconazole)
Enable (fenbuconazole)
Abound (azoxystrobin)

- *Chemical Rotation*. To delay resistance to the systemics by *M. fijiensis*, they are used in rotation with the protectant fungicides. For example, if a grower sprays every 14 days, the first application might be made with Dithane, or a mixture of Dithane and misting oil, followed two weeks later by an application of Elite. Most fungi remain susceptible to the protectants, so if some spores develop resistance to one of the systemics, they will be killed by the next spray of protectants. Some systemics can be mixed with protectants and sprayed at the same time. Systemics are grouped according to their mode of action. It is important to rotate systemics in the same group, like the triazoles (Elite and Enable), with those in another group, such the strobilurins (Abound) . If *M. fijiensis* becomes resistant to any member of a group, it will be resistant to other fungicides in the same group.

Until an acceptable BLS-resistant cultivar is developed, management of BLS depends on reducing the number of spores in a plantation by cultural methods, followed by a planned rotation of properly applied protectant and systemic fungicides.

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