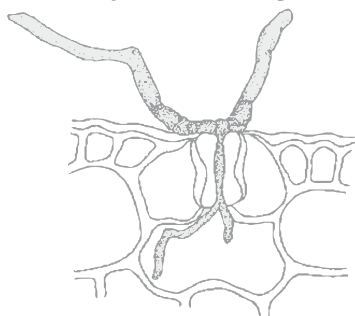


Conidia - yellow and black Sigatoka



Yellow and Black Sigatoka are banana leaf diseases caused by fungi. They cause significant drying of the leaf surface.

The fungi spread in two ways:

- by water which carries the conidia (asexual form of reproduction) from the upper to the lower leaves and suckers,
- by wind which carries the ascospores (sexual form of reproduction) in all directions.

The control of Sigatoka(s) enables the plant to conserve a sufficient number of healthy leaves up to harvest to ensure the normal growth of the fruit. The disease reduces the leaf surface and causes disturbances in the functioning of the plant, leading to a reduction in yield and quality (particularly a higher risk of fast ripening).

1. YELLOW SIGATOKA OR LEAF STREAK DISEASE (*Mycosphaerella musicola*)

■ The development of the fungus occurs in five stages:

FOR YELLOW SIGATOKA

- **Stage 1:** A tiny yellow spot or light green streak on the upper surface of leaves.

> Hardly observable.

YELLOW SIGATOKA **BLACK SIGATOKA**
Upper surface Lower surface



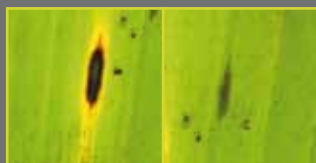
- **Stage 2:** The spots stretch out into yellow streaks of 3-4mm; this is the optimal stage for treatment.

> Streaks 1 to 5 mm.



- **Stage 3:** The streaks widen into large spots; the center developing a rusty colouration.

> Large spots.
CONTAMINATION +



- **Stage 4:** the lesion reaches its definite size (12-15 mm on 2-5 mm) with a yellow halo; the centre is dark brown to black.

CONTAMINATION ++



- **Stage 5:** The central zone of the lesion dries up and turns gray with a black ring and a yellow halo. It is referred to as the 'necrosis' stage. At this stage, the ascospores appear and are then dispersed by the wind.

> Necrosis.
CONTAMINATION +++



No
stage 6

- **Stage 6:** No stage 6.

STAGES OF YELLOW AND BLACK SIGATOKA
PHOTOS: CIRAD, SicaTG, IT 2

2. BLACK SIGATOKA OR BLACK LEAF STREAK DISEASE (*Mycosphaerella fijiensis*): A MORE VIRULENT FUNGUS

■ Black Sigatoka is present in almost all tropical banana producing zones but its arrival in the Lesser Antilles is very recent (2009-2010).

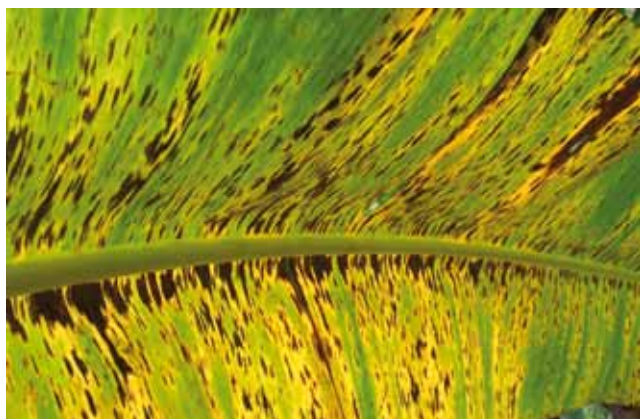
2.1-Description of symptoms and differentiation with Yellow Sigatoka

■ The symptoms of Black Sigatoka are sometimes not distinguishable from those of Yellow Sigatoka, especially in the advanced stages of necrosis, which are very similar. The difference is however evident at the early stages of evolution (1-4):

- **Stage 1:** Small whitish spots are only visible on the lower surface of the leaf.
- **Stage 2:** Brown rusty streaks are visible especially on the lower surface.
- **Stage 3:** Brown streaks lengthen and widen.
- **Stage 4:** Brown to black, round or elliptical broad stripes.
- **Stage 5:** The lesions become black, usually surrounded by a yellow halo.
- **Stage 6:** The centre of the stain dries up with a black halo, itself surrounded by a yellow halo.

2.2- More serious consequences

■ Black Sigatoka is more virulent than Yellow Sigatoka. Symptoms appear on younger leaves and cause more damage to the foliar system. The economic and environmental consequences are more important: yield loss, reduced shelf life, heavier maintenance tasks (deleafing) and increased plant protection (spraying).



Leaf attacked by Black Sigatoka - Photo IT²

Plantains are susceptible to Black Sigatoka but resistant to Yellow Sigatoka. Balisiers, heliconia, alpinia and porcelain roses are not susceptible to Black Sigatoka because they do not belong to the genus Musa.



Ripe bunch on the plant - Photo IT²

■ Control methods against Black Sigatoka are the same as those against Yellow Sigatoka: cultural practices (preventive and curative) and chemical control.

3. CULTURAL CONTROL METHODS

■ Good agricultural practices, preventive or curative, are essential to reduce pest pressure. Chemical treatments only act effectively on the young stages of development.



Cavendish banana attacked by Black Sigatoka - Photo IT²

3.1- Preventive Practices: to limit fungal population

- Cut all the leaves on the mother plant during harvest.
- Reduce humidity in your plots through a proper management of irrigation and drainage (drip or under foliage spray are less favourable to the development of the fungus than overhead sprinklers). Weeding, up to date de-suckering, a planting density of 1650-1850 plants/ha, and maintenance of edges, will allow good aeration of the plot.
- Quickly destroy all fallow plots to avoid creating infestation reserves.
- Eliminate all isolated bananas found at the edge of the plots, in the gullies, etc.

Healthy banana, receiving regular and balanced fertilization, resist more easily to the development of the disease.

3.2- Curative practices: eliminate the fungal population

- When only Yellow Sigatoka is present, proceed to a regular trimming (weekly) focused on the necrotic parts when they represent less than 20% of leaf surface, beyond this, remove the entire leaf. For Black Sigatoka, cut the entire leaf with necrosis, regardless of the level of infestation.
- To maintain a sufficient number of healthy leaves at harvest, be precise in the operations that can reduce leaf area (trimming and harvest of neighboring bunches). The objective is to maintain one functional leaf without necrosis per hand with a minimum of six leaves. Below six, the risk of advanced maturation of the bunch is high.



4. CHEMICAL CONTROL

4.1- Generalized aerial Treatment based on warning

■ Sigatoka control is rendered obligatory by a prefectorial order and is realised through a generalised aerial spray. The evolution of the disease is measured weekly based on climatic and biological indicators. A treatment program is established, based on this evolution, under the supervision of the team for generalised treatment.



Aerial treatment - Photo SICA TG

■ The fungicides available are of 2 types:

- Paraffin oil with fungistatic action, which blocks the development of the fungus and delays the onset of the 1st symptoms,
- Systemic fungicides, which have preventive and curative action on the early stages of the disease. In the French West Indies, few families of fungicides are currently allowed. The risk of resistance in regard to systemic products is high, that's why alternating treatment with oil alone then oil/fungicide is required.

4.2- Treatment on the ground with ZITA

■ The farmer is responsible for treatment on the ground in areas prohibited from aerial spraying (ZITA):

- Collect the products (fungicide and / or oil) from the generalised treatment centres and do the application following the schedule specified by the technical team of the centres,
- Carry out the treatment when temperatures are less than 28°C (early in the morning or after 4 PM) to avoid the drift phenomenon and phytotoxicity on banana. The wind must be less than Beaufort force 3 (19km/h),
- Respect the doses (15l mixture/ha), areas of non-treatment, time lapse to re-entre the plot and the pre-harvest interval, according to the chemical being used. Protect operator with appropriate personal protective equipment (PPE).

4.3- Treatment on the ground with a mistblower

■ Before treatment with the mistblower:

- Carry out trimming to aerate plot so that the product easily reaches the top leaves,
- Sleeve bunches to avoid oil spots on fruits
- Attach propping ropes in such a way as to facilitate the movement of the operator.

■ Using a mistblower with two possible modifications:

- Fixing of the blower tube at 45° towards the rear to limit the amount of chemical received by the operator,
- Mounting the sprayer gun in a vertical position above the operator facilitates swaying sideways to avoid touching bunches.

■ With treatment on every row, the treated surface is about 3 to 4 ha per person per day.



Modified mistblower: vertical gun / V-shaped double outlet nozzle
Photo BANAMART

4.4- Treatment with a canon:

■ The treatment can be done with a gun carried by a tractor moving along the corridors. This covers a width of 15 to 20 meters.

■ A new system comprising of a sprayer towed or mounted on a small carrier permitting passage at every four major rows is being experimented.

5. ALTERNATIVE CONTROL METHODS

5.1- Organic products

IT² is working on the possibility of using biological preparations in addition to chemical control to limit the emergence of resistance: yeast, vegetable oils and stimulators of natural defence systems. The objective is to reduce the use of chemicals by including biological preparations in an integrated treatment program.

5.2- Use of resistant varieties

In 2009, a platform for the selection of banana hybrids had been put in place in partnership with CIRAD and IT², at the CIRAD experimental station of Neufchâteau in Guadeloupe. Its aim is to intensify and accelerate the existing process of creating new dessert banana varieties that are resistant to diseases, including Yellow and Black Sigatoka. In the medium term, the goal is to succeed in creating a resistant hybrid that meets the criteria of the banana industry on a whole (production, transport, and marketing).

Reference links Banagap V5: CB 7.1 to CB 7.6 IPM.

