# Black sigatoka

**Common name:** Black sigatoka
**Kingdom:** *Fungi*
**Division***: Ascomycota*
**Class:** *Dothideomycetes*
**Order:** *Mycosphaerellales*
**Scientific names:** *Mycosphaerella fijiensis*
**Host** Banana (*Musa sapientum*)

**Distribution -** Black leaf streak disease (BLSD), caused by the fungus Mycosphaerella fijiensis Morelet (Stover 1980), was first recognized on the South-eastern coast of Viti Levu in Fiji in 1963 (Rhodes 1964). Subsequently, the disease was reported in the Pacific Islands, Asia, Africa, in Latin America and in  La Lima and Honduras in 1972.

**Economic importance -** Black Sigatoka is a fungal disease that can cut yields by up to three quarters and reduces the productive lives of banana plants from 30 to only 2 or 3 years. In the last years it has become a global epidemic. The disease spread is an important aspect considering that bananas are considered a staple food in Latin America and Africa.

**Life cycle -** The same conditions required for optimum plant growth are also conducive for development of black Sigatoka. The disease does not develop well under cool conditions or areas of high elevations. Shading can reduce symptoms expression. The fungus is haploid through most of its life cycle and reproduces both asexually and sexually, via conidia and ascospores, respectively.
Conidia and ascospores are important in its dispersal. The conidia are mainly water-born to short distances, while ascospores are carried by wind to more remote places (the distances could be limited by their susceptibility to ultraviolet light). Over sixty distinct strains with different pathogenetic potentials have been isolated.

**Damage -** Black Sigatoka is one of the most devastating leaf-destroying diseases. This disease also sometimes known as black leaf streak, causes significant leaf area reduction, yield losses of 50% or more, and premature ripening.

**Control -** Black Sigatoka is controlled by frequent applications of fungicides. Usually the banana farms have small dimension and product for local market; the farmers haven't the possibility to afford expensive measures to fight the disease. However, some cultivars of banana are resistant to the disease. Research is carried out to improve productivity and fruit properties of these cultivars. A genetically modified banana variety made more resistant to the fungus has recently been developed and will be soon field tested. The main good practice to contrast the disease spread are: removal of affected leaves and a good drainage.

Prof. Simone Orlandini, DIPSA-UNIFI, piazzale delle cascine 18, Firenze (IT)
CAMI Workshop, 4-5 April 2011

**Model -** Some Model are used to forecast the life cycle of the pathogen and to provide some useful indication for farmer in the fight.

→<u>The Model for *Conidia Formation* uses relative humidity and air temperature.</u>

**Humidity≥70% and 27-30°C for 24 hours**
**or**
**Humidity≥ 70% for 32 hours**

→<u>The Model for *Ascospore formation* uses temperature and relative humidity too.</u>

**relative humidity ≥70% and 27-30°C for 48 hours**
**or**
**relative humidity≥70% and temperature < 27-30°C for >48 hour**

The main amount of ascospores is released at the beginning of the rain.

→<u>The *Infection* takes place during periods of:</u>

**leaf wetness**
**or**
**relative humidity > 90%**

Under optimum temperature infection is completed in less than > 12 hours of moist conditions. If temperature is not that high it will need 15 to 24 hours.

→<u>The *risk model* is based on Potential Evapotranspiration</u>. If the accumulated Evapotranspiration for the last 7 days is:

40 mm No Risk
> 30 mm Low Risk
> 22 mm Average Risk
< 22 mm High Risk

→<u>The second risk evaluation model</u> uses the results of the infection model to prove for infection and the range of precipitation during this infection to assess the importance of this infection events.

- infection with 0 mm rain →severity = 1
- infection with <2, 5 and 10 mm of rain →severity = 2,3 - 4.
- infection with >10mm of rain →severity = 5.

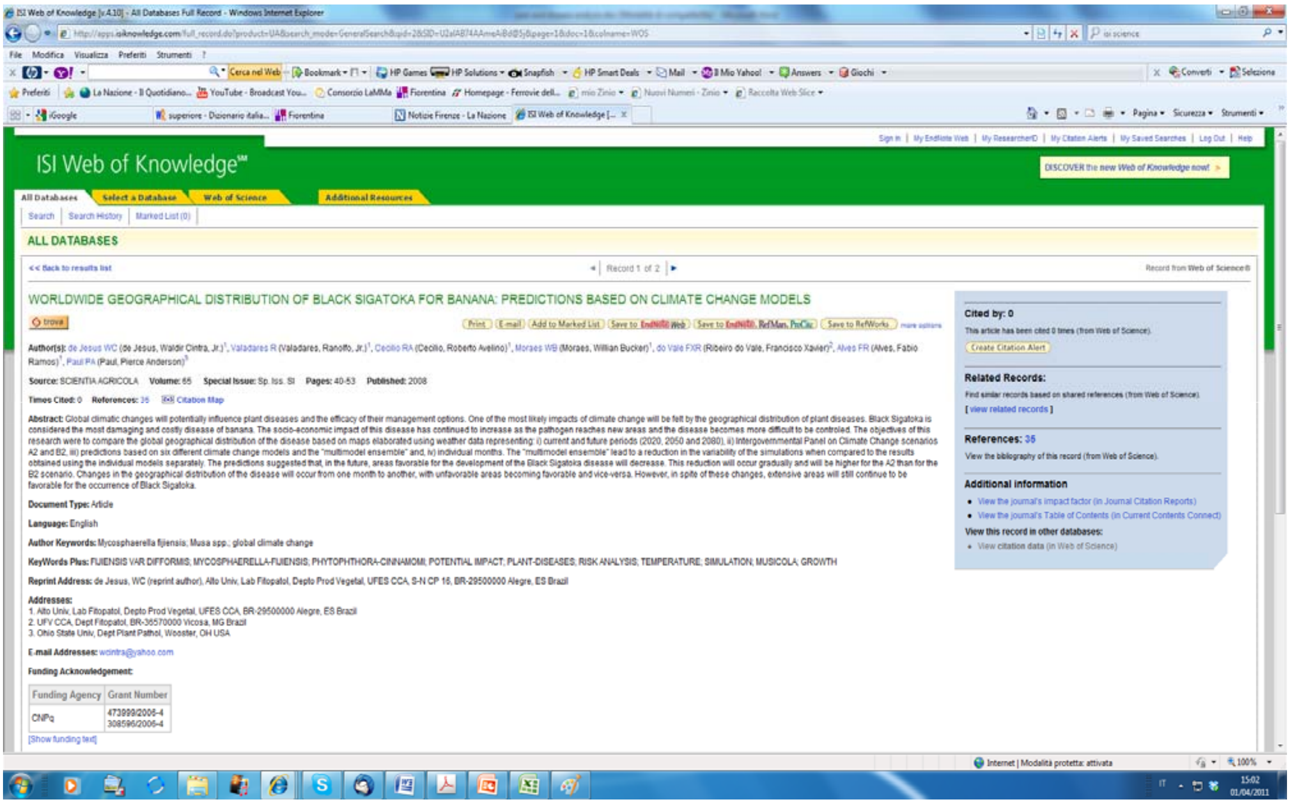
The risk indication is done by the accumulation of this severity values for the last 4 days.

-if we accumulate 0 there is **no** risk.

-if we accumulate less than 4 there is a **low** risk of Sigatoka.

- if we accumulate in between 4 and 12 there is a **moderate** risk and

- if we accumulate more than 12 within the last 4 days the risk is **stated to be high**.



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WORLDWIDE GEOGRAPHICAL DISTRIBUTION OF BLACK SIGATOKA FOR BANANA: PREDICTIONS BASED ON CLIMATE CHANGE MODELS

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**Source:** SCIENTIA AGRICOLA **Volume:** 65 **Special Issue:** Sp. Iss. SI **Pages:** 40-53 **Published:** 2008

**Times Cited:** 0 **References:** 35 Citation Map

**Abstract:** Global climatic changes will potentially influence plant diseases and the efficacy of their management options. One of the most likely impacts of climate change will be felt by the geographical distribution of plant diseases. Black Sigatoka is considered the most damaging and costly disease of banana. The socio-economic impact of this disease has continued to increase as the pathogen reaches new areas and the disease becomes more difficult to be controled. The objectives of this research were to compare the global geographical distribution of the disease based on maps elaborated using weather data representing: i) current and future periods (2020, 2050 and 2080), ii) Intergovernmental Panel on Climate Change scenarios A2 and B2, iii) predictions based on six different climate change models and the "multimodel ensemble" and, iv) individual months. The "multimodel ensemble" lead to a reduction in the variability of the simulations when compared to the results obtained using the individual models separately. The predictions suggested that, in the future, areas favorable for the development of the Black Sigatoka disease will decrease. This reduction will occur gradually and will be higher for the A2 than for the B2 scenario. Changes in the geographical distribution of the disease will occur from one month to another, with unfavorable areas becoming favorable and vice-versa. However, in spite of these changes, extensive areas will still continue to be favorable for the occurrence of Black Sigatoka.

**Document Type:** Article

**Language:** English

**Author Keywords:** Mycosphaerella fijiensis; Musa spp.; global climate change

**KeyWords Plus:** FIJIENSIS VAR DIFFORMIS; MYCOSPHAERELLA-FIJIENSIS; PHYTOPHTHORA-CINNAMOMI; POTENTIAL IMPACT; PLANT-DISEASES; RISK ANALYSIS; TEMPERATURE; SIMULATION; MUSICOLA; GROWTH

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**Funding Acknowledgement:**

| Funding Agency | Grant Number |
|---|---|
| CNPq | 473999/2006-4<br>308596/2006-4 |

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# Citrus Psyllids

**Common name:** Citrus Psyllids
**Class:** *Insecta*
**Order:** *Hemiptera*
**Suborder:***Sternorrhyncha*
**Superfamily:***Psylloidea*
**Family:***Psyllidae*
**Scientific names:** *Diaphorina citri*
**Host** Gen: *Cytrus*

**Distribution**
The Asian citrus psyllid is originated in Asia but it is now also found in parts of the Middle East, South and Central America, Mexico and the Caribbean

**Economic importance**
Citrus greening, also called Huanglongbing or yellow dragon disease, is one of the more serious diseases of citrus.
It is an important pest of citrus in several countries, particularly India, where there has been a serious decline of citrus yield for this reason in recent years.
This bacterial disease is thought to have originated in China in the early 1900s. The disease is primarily spread by two species of psyllid insects. D. citri and Trioza erytreae are the only two known vectors of the etiologic agent of citrus greening disease and are the only economic species on citrus in the world. The bacteria itself is not harmful to humans but the disease has harmed trees in Asia, Africa, the Arabian Peninsula, and Brazil. There are three strains of the bacteria, an Asian, an African version, and a recently described American strain discovered in Brazil.

**Life cycle**
Eggs are laid on tips of growing shoots on and between unfurling leaves. Females may lay more than 800 eggs during their lives. Nymphs pass through five instars. Total life cycle requires from 15 to 47 days, depending upon the season. Adults may live for several months. There is no diapause but populations are low in winter (the dry season). There are 9 to 10 generations a year; 16 have been observed in field cages.

**Damage**
Psyllid nymphs are found on new shoots of citrus trees. As they feed they produce a toxin that causes the plant tips to die back or become contorted and prevents the leaves expanding normally.

The most serious damager caused by Asian citrus psyillid is due to its ability to efficiently vector of a bacterium that cause citrus greening disease “huanglongbing” (HLB Bacterial disease). The main consequence on the affected trees is small and asymmetrical fruit, partially green with poor size and quality.

**Control**

This insect has a number of natural enemies including hoverflies, lacewings, several species of ladybird and a number of species of parasitic wasp. Both adults and nymphs of the psyllid can be controlled by the use of a wide range of insecticides. Citrus greening disease is best controlled through an integrated strategy involving the use of healthy planting material, the prompt removal of infected trees and branches and the control of vectors. There are model to simulate the biology and model to simulate the distribution.

**Sources**

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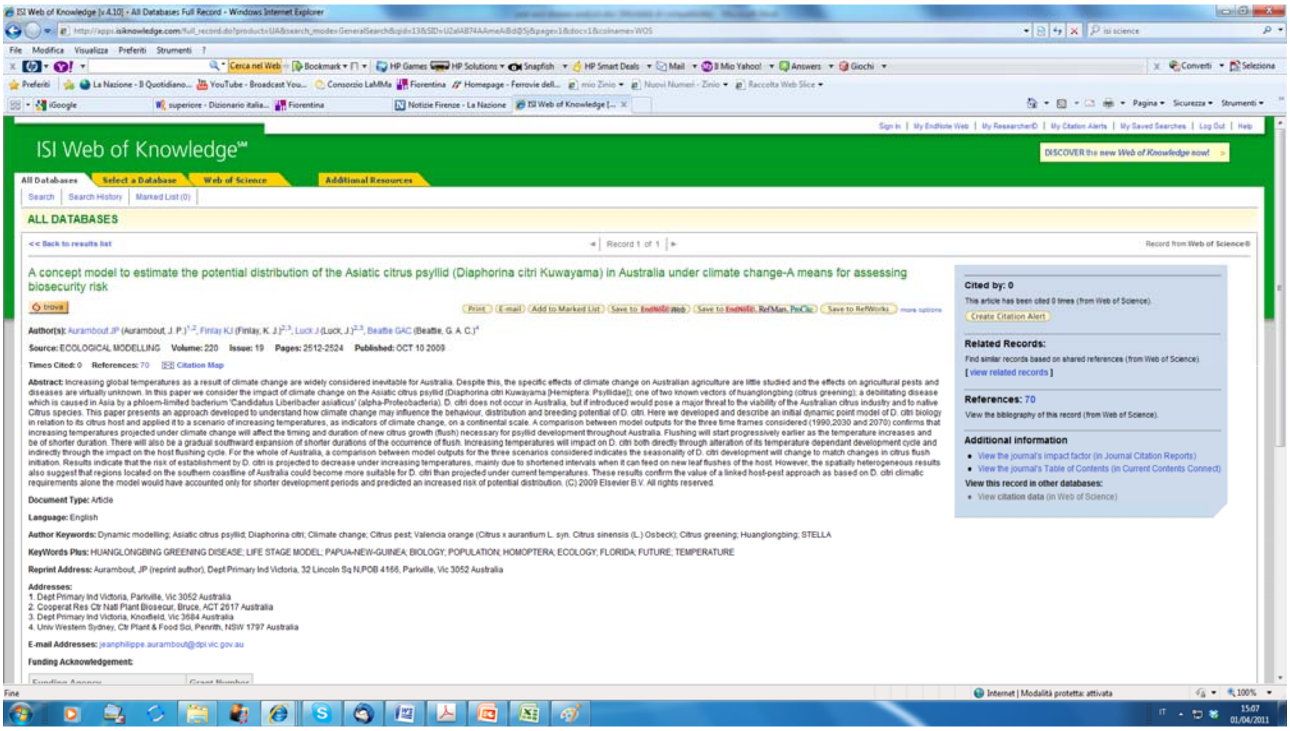


# Whitefly


**Common name:** *Silverleaf whitefly*
***Class:*** *Insecta*
**Order:** *Hemiptera*
**Superfamily:***Aleyrodoidea*
**Family:***Aleyrodoidea*
**Scientific names:** *Bemisia tabaci, Biotype B (= B. argentifolii)*
**Host** Vegetables ( specially tomatoes and peppers)

**Distribution**
Bemisia tabaci possibly originated in India and as a result of widespread dispersal, particularly during the last 15 years, is now distributed nearly worldwide. Bemisia tabaci is also a vector of over 100 plant viruses in the general Begomovirus (Geminiviridae), Crinivirus (Closteroviridae) and Carlavirus or Ipomovirus. In the United States, the silverleaf whitefly was identified as a serious pest in Florida in 1986 (Barinaga, 1993). By 1991, the silverleaf whitefly had spread across the southern United States (Arizona, California, Florida, Georgia, , New Mexico, Texas, Hawaii island)

**Economic importance**
The silverleaf whitefly Bemisia tabaci(Genn.) B-biotype is a polyphagous insect attacking many plant species of economic importance as sweet potato, pepper, tomato, cucumber and cotton.

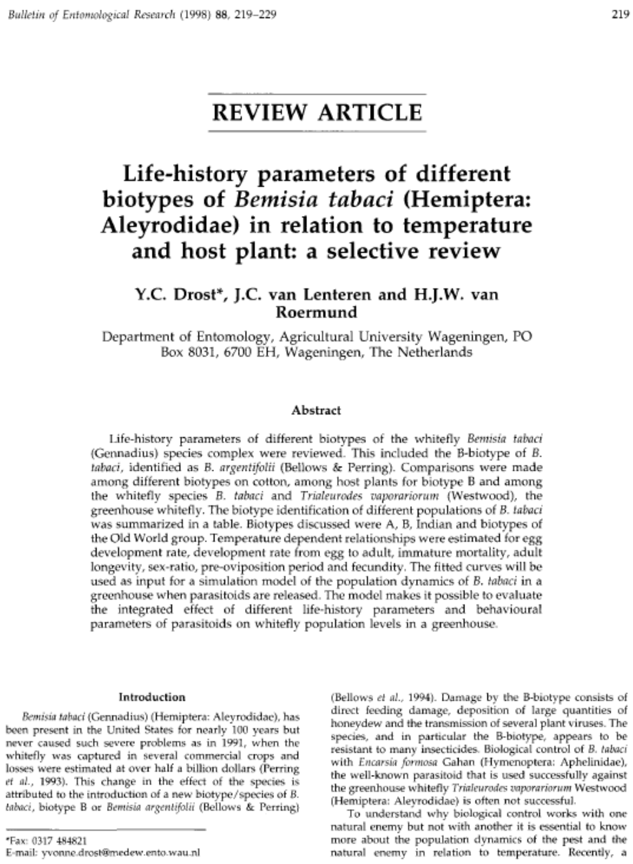
**Life cycle**
Whiteflies have six life stages - the egg, four nymphal stages, and the adult. The development time of this insect from egg to adult may range from 15-70 days dependent upon temperature and plant host. Development occurs in temperatures ranging from 50 to 89.6°F (10 to 32°C). 80.6°F (27°C) appears to be the optimal temperature for development. Under control conditions on cotton, the pest completes its development in 17 days at 86°F (30°C) On the continental U.S. development from egg to adult under field conditions varies with the season; development varies from 25 to 50 days..
EGGS -Female whiteflies deposit pear-shaped eggs into the mesophyll or inner tissue of the leaf from the lower surface. Eggs are attached to the leaf by a stalk-like process. Eggs are white when first laid, and become brown prior to hatching. They are generally laid on the underside surface of the younger, upper leaves of the plant. Females lay from 28-300 eggs depending on host and temperature. Low temperatures increase mortality. However, humidity is not a factor in egg mortality and egg incubation periods.

NYMPHS-The first nymphal stage is called crawlers and the last stage is often referred to as the pupa. After hatching the crawlers move a short distance and settle to feed. Once settled, the subsequent three nymphal stages are scale-like and sedentary. Nymphs are creamy white to light green and oval in outline. The total nymphal period lasts about 2-4 weeks.
ADULTS-Adults usually emerge from their pupal cases in the morning hours and may copulate a few hours later. Oviposition occurs from 1 to 8 days after mating. Adult life span ranges from 6-55 days dependent on

temperature. Females live only 10-15 days under southern continental U.S. summer conditions, but can live several months during the winter.
In this species, reproduction can occur with or without copulation. Unmated females can reproduce by parthenogenesis in which the females produce only male progeny. Females lay 80 to more than 300 eggs in their lifetime. The plant host reportedly plays an important role in female fecundity.

**Damage**
Damage is caused not only by direct feeding, but also through transmission of viruses. Begomoviruses are the most numerous of the B. tabaci transmitted viruses and can cause crop yield losses of between 20% and 100%.
Direct feeding damage is caused by the piercing and sucking sap from the foliage of plants. This feeding causes weakening and early wilting of the plant and reduces the plant growth rate and yield. It may also cause leaf chlorosis, leaf withering, premature dropping of leaves and plant death. Infestations of whitefly nymphs are associated with the occurrence of irregular ripening of tomatoes and silverleaf of squash. Indirect damage results by the accumulation of honeydew produced by the whiteflies. This honeydew serves as a substrate for the growth of black sooty mold on leaves and fruit. The mold reduces photosynthesis and lessens the market value of the plant or yields it unmarketable. The third type of damage is caused by the vectoring of plant viruses by this insect. A small population of whiteflies is sufficient to cause considerable damage. Plant viruses transmitted by whiteflies cause over 40 diseases of vegetable and fiber crops worldwide. Among the 1,100 recognized species of whiteflies in the world, only three are recognized as vectors of plant viruses. The whitefly is considered the most common and important whitefly vector of plant viruses worldwide. It is also the only known whitefly vector of viruses categorized in the geminivirus group.

**Control**
Several wasps, including species in the Encarsia and Eretmocerus genera, parasitize whiteflies. Whitefly nymphs are also preyed upon by bigeyed bugs, lacewing larvae, and lady beetle larvae. Silverleaf whitefly is an introduced pest that has escaped its natural enemies. Some indigenous native parasites and predators do attack it, but do not keep it below damaging numbers. The best control for silverleaf whiteflies is to maximize the distance and time interval between host crops. When possible, plant peppers at least one-half mile upwind from key silverleaf whitefly hosts such as melons, cole crops, and cotton. Maintain good sanitation in areas of winter/spring host crops and weeds by destroying and removing all crop residues as soon as possible. Control weeds in non crop areas including head rows and fallow fields and harvest alfalfa on as short a schedule as possible. In addition, allow the maximum time between silverleaf whitefly host crops and produce vegetables and melons in the shortest season possible.


*Bulletin of Entomological Research* (1998) **88**, 219–229 219

REVIEW ARTICLE

**Life-history parameters of different biotypes of *Bemisia tabaci* (Hemiptera: Aleyrodidae) in relation to temperature and host plant: a selective review**

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**Abstract**

Life-history parameters of different biotypes of the whitefly *Bemisia tabaci* (Gennadius) species complex were reviewed. This included the B-biotype of *B. tabaci*, identified as *B. argentifolii* (Bellows & Perring). Comparisons were made among different biotypes on cotton, among host plants for biotype B and among the whitefly species *B. tabaci* and *Trialeurodes vaporariorum* (Westwood), the greenhouse whitefly. The biotype identification of different populations of *B. tabaci* was summarized in a table. Biotypes discussed were A, B, Indian and biotypes of the Old World group. Temperature dependent relationships were estimated for egg development rate, development rate from egg to adult, immature mortality, adult longevity, sex-ratio, pre-oviposition period and fecundity. The fitted curves will be used as input for a simulation model of the population dynamics of *B. tabaci* in a greenhouse when parasitoids are released. The model makes it possible to evaluate the integrated effect of different life-history parameters and behavioural parameters of parasitoids on whitefly population levels in a greenhouse.

**Introduction**

*Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae), has been present in the United States for nearly 100 years but never caused such severe problems as in 1991, when the whitefly was captured in several commercial crops and losses were estimated at over half a billion dollars (Perring *et al.*, 1993). This change in the effect of the species is attributed to the introduction of a new biotype/species of *B. tabaci*, biotype B or *Bemisia argentifolii* (Bellows & Perring) (Bellows *et al.*, 1994). Damage by the B-biotype consists of direct feeding damage, deposition of large quantities of honeydew and the transmission of several plant viruses. The species, and in particular the B-biotype, appears to be resistant to many insecticides. Biological control of *B. tabaci* with *Encarsia formosa* Gahan (Hymenoptera: Aphelinidae), the well-known parasitoid that is used successfully against the greenhouse whitefly *Trialeurodes vaporariorum* Westwood (Hemiptera: Aleyrodidae) is often not successful.

To understand why biological control works with one natural enemy but not with another it is essential to know more about the population dynamics of the pest and the natural enemy in relation to temperature. Recently, a

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## Models

A preliminary analysis shows that the epidemiology of the insect has been studied and this can represent the basis for the development of simulation models