# MAIN PESTS AND DISEASES OF BANANAS ON MADEIRA ISLAND

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## *Abstract*

Banana cultivation on Madeira Island (Portugal), has an enormous social, economic and landscape importance. The main cultivars used are "Dwarf Cavendish", "Robusta", "Grande Naine Israel" and "Gal" always grown in the open air, mainly on the south coast, with temperate to subtropical climate. The planted area occupies approximately 850 hectares.

This paper gives an overview of the main pests and diseases that affect banana production, which are [Insects]: *Cosmopolites sordidus*, *Thrips exilicornis*, *Opogona sacchari*; [Mites]: *Tetranycus urticae*; [Nematodes]: *Helicotylenchus multicinctus*, *Pratylenchus brachyurus*, *P. coffeae*, *P. goodeyi*, *Rotylenchulus reniformis*, *Meloidogyne incognita* and *Meloidogyne* sp.; [Fungi]: *Fusarium oxysporum* f. sp. *cubense* and *Verticillium theobromae*.

These organisms are arranged on this work by order of damage caused to banana in terms of quality, quantity, frequency, affected area and the efficacy of the control measures. This arrangement based on the above criteria includes four categories namely: very important, occasionally very important, important and occasionally important.

For each one these problems will be discussed data regarding the present situation including its distribution on the Island, commonly used control measures, favourable developing conditions and damage caused

## *Introduction*

### Banana – the crop then and now.

The first banana plants were introduced in Madeira during sixteenth century just as a botanical curiosity (Ribeiro 1992). Cultivar "Dwarf Cavendish" introduced for commercial purposes at the middle of the nineteenth century represents presently

60% of the total banana cultivated area which is close to 850 ha. The remaining area is occupied by cultivars “Robusta” (32%), “Grand Naine - Israel” and “Gal” (8%), all introduced in 1993.

Bananas are mainly cultivated in the South coast of the Island where they benefit of a temperate to subtropical environment with average temperatures ranging from 16º to 22º C and a relative humidity of 71%. The main limiting climatic factors are the exposure to occasional strong winds and the extreme minimum, temperatures ranging from 10-12º C, which sometimes occur during December-February (Ribeiro & Silva 1998). Presently the traditional banana planting system, with cultivar “Dwarf Cavendish” and “Robusta” uses 2.500 plants/ha compared with 1.600 plants/ha of the new planting-system using cultivars “Grand Naine-Israel” and “Gal”. The traditional irrigation system of watering channels is being substituted by localised irrigation systems.

The introduction of new cultivars and upgrading of the traditional planting system translates on productivity and quality gains. The total production for 2000 was 23.000 tons with an average productivity of 27 tons/ha.

## *Results*

### Main pests and diseases of banana on Madeira Island

1. Insects

1.1. *Cosmopolites sordidus* (Germar) [Coleoptera: Dryophthoridae].

The detection of the banana weevil-borer in the island dates back to the nineteenth century (Wollaston 1876). According to Vilardebó & Cuillè (1962), this pest could only be found sporadically in Madeira and the Canary Islands and never causing damage to plantations like those occurring in tropical regions and in particular in West Africa. The reason for this was, according to these authors, the temperate climate of the archipelago, which prevented optimal developmental conditions for the pest. Although in 1988 almost no insecticide treatments were used against it, presently the situation has changed, mainly since the introduction of new cultivars, planting and irrigation systems (Vieira 1988).

On the last years, with the adoption of new agricultural practices like drip irrigation and the abandonment of practices like the burying of the crop residues, the weevils found better conditions to develop. Insecticide application is now more frequent as is the use of traps made of freshly cut-up pieces of pseudostem lying on the plantation floor to attract adult weevils, which are then destroyed. Normally this

pest attacks plants that had already produced, but due to its all year round activity, high production losses are frequent.

1.2. *Opogona sacchari* (Bojer) [Lepidoptera: Tineidae].

The first written record of this species in Madeira was by Lord Walsingham (1910). This polyphagous insect was probably introduced with the first banana plants imported to the Island. It exists in almost all regions of the world where banana is cultivated. In 1965, the Agricultural Services begun to advice farmers about ways to control the pest which was frequently causing damage. Although preferring decomposing and decomposed tissues to develop, the larvae of *O. sacchari* easily attack nearby healthier tissues. Bearing in mind these facts it was recommended to avoid letting in the plantations any kind of crop residues like dry leafs, flowers, bracts and pieces of pseudostems, near the plants still in production and the new stools. Only in cases of particularly serious attacks were insecticide applications recommended, although with low efficacy due to larvae being protected inside the tissues against the contact insecticides commonly used.

Today the pest is common on plantations with deficiencies on the removal of crop residues and plantations with a high density of plants. The attacks directed to the fruits occur more frequently during months with higher humidity and lower temperatures (November to April). The use of polyethylene bags as bunch covers for gains in weight creates favourable conditions for the pest to develop and in these cases the damages are heavy. In Madeira *O. sacchari* is spread all over the banana plantations. Another frequently attacked host is *Strelitzia reginae*, mainly those bordering banana plantations.

1.3. *Thrips exilicornis* HOOD [Thysanoptera: Thripidae].

Although Vieira (1988) mentioned *Heliothrips haemorrhoidalis* as the species that occasionally attacked the fruits, the most frequently detected thrips species since 1996 in banana is *T. exilicornis* (A. Aguiar pers.comm.). This species belongs to the *T. hawaiensis* species complex and its distribution is restricted to some areas of West Africa. In Madeira, adults are frequently collected within the banana flowers where they feed on pollen and on the young fruit skin, causing scarring. The damage caused to fruits shows similar symptoms to those caused by spider mites.

The attacks are more frequent in hot weather (April to October) and high humidity levels. In these conditions, the damage to fruits can be high, which prompt farmers to regularly apply insecticide treatments. The enhancement of ventilation in the plantations using a lower number of plants and the removal of old leaves, creates unfavourable conditions for *T. exilicornis* development. For the contrary, these same

measures are highly favourable for spider mites, particularly the species described below. *T. exilicornis* prefers the less exposed (darker and more humid) parts of the bunch and again the contrary happens with spider mite attacks, which are heavier in bunch parts more exposed to light, higher temperatures and lower humidity.

2. Spider Mites

2.1. *Tetranychus urticae* KOCH [Acarina: Tetranychidae].

Damage caused by spider mites are also frequent. Although Carmona (1992) identified *Tetranychus ludeni* Zacher on a banana fruit sample collected in Câmara de Lobos in 1987, this is not the only Tetranychid mite affecting bananas. The most frequent one is *T. urticae* Koch, a species already related to banana fruit damage by Vieira (1988) under the name *T. telarius* (L.), a synonym of *T. urticae*. This is a highly polyphagous spider mite with worldwide distribution. In Madeira according to Aguiar & FÉLIX (1997) it has also many host plants, including important protected crops (vegetables and ornamentals).

For Vieira (1988) the attacks are more frequent exclusively during summer months in hot sunny places, when the weather is dryer. Presently farmers control this pest with applications of specific acaricides.

3. Nematodes

3.1. *Helicotylenchus multicinctus* (Cobb) Golden [Tylenchida: Hoplolaimidae]

*Helicotylenchus multicinctus* is the most common nematode in the Island and it appears in great number in banana plantations. In Madeira *H. multicinctus* appears normally associated with nematodes of the genera: *Pratylenchus*, *Rotylenchulus* and occasionally with *Meloidogyne* and *Paratylenchus*.

Nematodes of the species *H. multicinctus* are vermiform, with a “C” shape to arcuate body when relaxed and also possess a very well developed stylet with prominent basal knobs (Fortuner 1991). They are endoparasites of the roots cortex where they feed. They can cause bad development of the plants, lengthening of the vegetative cycle, reduction in the size and weight of the bunch, which have negative influence in the productivity of the plantations. In cases of heavy infestation they can cause toppling of the plants. In primary roots the injuries in the form of small red-brownish or black lines are, in a general way less deep. However, in severe infestations, they can originate an extensive necrosis in the outer cortex of the roots (Gowen & Quénéhervé 1990).

3.2. *Pratylenchus goodeyi* Sher & Allen [Tylenchida: Pratylenchidae]

Nematodes of the genus Pratylenchus are small, less than 1 mm, vermiform, with short, stout and well-developed stylet. They are migratory root cortex endoparasites (Loof 1991), normally known as “necrotic root lesions nematodes”. They cause important damages in several cultures. In Madeira Island *P. goodeyi* appears more frequently in banana plantations and in higher numbers. Normally they occur in association with other nematodes of the genera *Helicotylenchus* and *Rotylenchulus*.

The main host of *P. goodeyi* is banana, to whom they cause small injuries but if these lesions coalesce they can originate the total destruction of the roots. The damage symptoms are stunting of plants, lengthening of the vegetative cycle, reduction in size and number of leaves and in bunch weight, reduction of the productive life of the plantation and toppling (Gowen & Quénéhervé 1990).

3.3. *Pratylenchus brachyurus* (Godfrey) & *P. coffeae* (Zimmerman)

*P. coffeae* and *P. brachyurus* are less frequent and appear in association with other nematodes, and nematological analyses are necessary to detect its presence. *P. coffeae* is an important and relatively widespread parasite of banana. *P. brachyurus* is widely distributed throughout the tropics and subtropics, originally described as a damaging pest of pineapples in Hawaii (Godfrey 1929) but they attack several other cultures. In Madeira this nematode occurs always in association with other nematodes.

3.4. *Meloidogyne incognita* (Kofoid & White) Chitwood & *Meloidogyne* sp. [Tylenchida: Heteroderidae]

*Meloidogyne incognita* and *Meloidogyne* sp. root-knot nematodes have a worldwide distribution attacking many economically important crops. At least five different species of *Meloidogyne* were found in association with banana crops (Gowen & Quénéhervé 1990). In Madeira, *M. incognita* is the more frequent. However, in the same gall it can be found different nematodes of the same genus. Nevertheless, in most cases *M. incognita* doesn’t cause visible symptoms in pseudostems, leaves and other aerial parts of the plant, but when a great infestation occur, the plants become weak and sometimes primary and secondary root galling causes bifurcation and distortion.

3.5. *Rotylenchulus reniformis* Lindford & Oliveira [Tylenchida: Hoplolaimidae]

*Rotylenchulus reniformis* is associated with a great number of cultures in tropical and subtropical countries. The adult females are sedentary semi-endoparasites, capable of survive in a air-dried soil for a long period of time, while males are non-parasitic. The symptoms of their presence are root discoloration and shedding of the leaves. In addition to causing direct damage, they interact with other important plant pathogens such as *Fusarium* and *Verticillium* species and *Rhizoctonia solani* in the development of disease complexes. They also interact with other plant parasitic nematodes such as *Meloidogyne* and *Pratylenchus* species (Jatala 1991) and in Madeira Island they occur frequently together with *Helicotylenchus* genera.

4. Fungi

4.1. *Fusarium oxysporum* f. sp. *cubense* (E. F. Sm.) W. C. Snydeer & H. N. Hans [Hyphomycetes: Tuberculariaceae]

Banana Fusarium Wilt, also known as Panama disease, caused by *F. oxysporum* f.sp. *cubense* is the most important fungus that attacks banana plants in Madeira Island, constituting more than 50% of the fungi identified on this crop (Rodrigues & Sardinha 1999).

The first infection was detected in 1973 on a plantation in Funchal. Since then, several infections were observed along the south coast of the Island, with different degrees, varying according to the farming practices and the time of the year. Symptoms are much more evident in summer. The appearance of new infections is due to the use of infected vegetative material when establishing new plantations. The losses attributed to this vascular disease and the fact that even without banana plants the fungus can survive for a long period in the soil in the form of clamidospores, weed parasites or in host remains, led to a small scale replacement of banana with other and more profitable crops.

Panama disease treatment with fungicides is ineffective. To prevent higher losses, cultural practices have been recommended in order to avoid conditions that would favour the pathogen and the spread of the disease. Better soil drainage, higher soil pH (lime application), correct fertilisation and addition of organic matter are very important cultural practices. The disinfection of farming tools and machinery with sodium hypochlorite is also very important. New irrigation techniques (drip irrigation) are recommended to replace the traditional flooding irrigation. Dead plants should be removed with as many roots as possible and burned.

4.2. *Verticillium theobromae* (Turconi) E. Mason & S. J. Hughes [Hyphomycetes: Moniliaceae]

According to Rodrigues & Sardinha (1999), cigar-end rot caused by *Verticillium theobromae* is an economically important disease in Madeira Island accounting for 12,5% of the fungi detected on banana plantations. It is the main cause of the dry rot on the fruit tip resembling a burnt cigar tip. The frequency of cigar end rot increases during periods of high humidity and rainfall. Wind is the main dissemination vector and the optimum growth temperature of *V. theobromae* is 25ºC.

Good agricultural practices are advised such as low planting densities, removal of old leaves and frequent removal of dead flowers and bracts aiming to avoid dying flower parts that easily would be infected with the fungus conidia. These practices should be complemented with preventive treatments with tirame after the removal of flower residues. Normally farmers don't apply the treatments and practices listed above, and so this disease is considered important due to the losses observed.

## *Discussion*

### Pest importance and damage evaluation

The adopted classification (see Figure 1) to define the importance of the principal pests and diseases of banana in Madeira is based on the practical experience gathered through fieldwork developed during the last decade. This includes knowledge about frequency and importance of the considered pests and diseases, loss of productivity and production quality, and efficacy of the adopted control measures.

Figure 1. Classification of banana pests & diseases according the importance of damages they cause

| Problem | Causing organism | Importance* |
|---|---|---|
| Insects | *Cosmopolites sordidus* | *VI* |
| | *Thrips florum* | OVI |
| | *Opogona sacchari* | I |
| Spider Mites | *Tetranychus urticae* | OVI |
| Nematodes | *Helycotylenchus multicinctus* | VI |
| | *Pratylenchus goodeyi* | I |
| | *Rotylenchulus reniformis* | I |
| | *Meloidogyne incognita* | OI |
| | *Meloidogyne sp.* | OI |
| | *Pratylenchus brachyurus* | OI |
| | *Pratylenchus coffeae* | OI |
| Fungi | *Fusarium oxysporum* f. sp. *cubense* | VI |
| | *Verticillium theobromae* | I |

*VI – Very important; I – Important; OVI – Occasionally very important; OI – Occasionally important.

**Future perspectives for control strategies.**

Until now the control strategies taken against banana pests and diseases in Madeira are based exclusively on chemical treatments. For some pests, like thrips and spider mites, there is the additional difficulty of absence of banana-registered insecticides. Work is currently under development with the objective of registering chemicals that are more selective.

Farmers will have to be more aware of the necessity to adopt planting systems less favourable to the referred phytofagous organisms. Namely the use of a lower plantation density and removal of old leaves as a means of promoting air circulation and consequently less favourable conditions to thrips and cigar-end-rot infections. Correction of soil pH, rising of organic matter levels and the adoption of balanced fertilisations are desirable as means to prevent pest and disease problems.

The control of nematode populations would still be important to prevent damages. It will be convenient the use of preventive measures such as adequate fertilisations, disinfections of farming instruments, using plants from tissue culture, in previously disinfected soils. Although already in use, the utilisation of tissue cultured plantlets free of pathogens to establish new plantings should be adopted in the near future as obligatory, leading to the decrease of infection problems in new areas.

Studies on the use of fermented manure, colonised with antagonistic organisms of *F. oxysporum* f. sp. *cubense*, as well as the effort of several banana producing countries to develop resistant cultivars with agricultural value are new ways to control this disease.

Regarding insect and nematode pests, one of the challenges in the present is the study of alternative control methods, like the use of natural insecticides and biological control. Future work will have obligatorily to be based in environment-friendly solutions in order to avoid pollution and unbalanced ecosystems.

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