Study of The Incidence of Black Leaf Streak Disease (BLSD) On Banana in The Comoros

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Abstract

Black leaf streak disease (BLSD) or Cercosporiose, caused by the ascomycete fungus *Mycosphaerella fijiensis* (black Sigatoka), is one of the most devastating diseases of banana trees (*Musa spp.).* It is a major constraint on its production, especially in the humid tropics where banana is a basic food crop. The objective of this work was to study the impact of black leaf streak disease in the Comoros Islands in order to evaluate integrated protection strategies to be developed in banana crops. Field experiments have made it possible to better understand the epidemiological characteristics disease according to seasons and crop systems. It is clear that the seasons thus encountered play an important role in the epidemiology of the disease. The incidence of the disease was slightly lower in the dry season than in the wet season. These results provided new information on the epidemiology of the disease in the Union of Comoros and on the characteristics of the population involved. They were used to establish a list of recommendations aimed at better managing the damage of *Mycosphaerella fijiensis,* a pathogen with significant evolutionary potential.

Keywords: Black Sigatoka, *Mycosphaerella fijiensis*, banana, damage, Comoros.

INTRODUCTION

Agriculture is the basic economic activity of people in developing countries who benefit from the high incomes of the rural world. Among the crops, the banana occupies a prominent place as a cash crop and food crop. Plantains and bananas are a group of considerable agricultural, food and economic importance worldwide[1].

Bananas are the most consumed fruit in the world and in West Africa. However, banana plantations are often attacked by an ascomycete fungus called *Mycosphaerella fijiensis* , responsible for black skate disease (BLSD) or black cercosporiose with yield losses greater than 50% [2]. Banana farming is faced with numerous parasitic diseases that significantly reduce yields, resulting in loss of financial income and food.

Black Skate Disease (BSD) due to the fungus Ascomycete (*Mycosphaerella fijiensis Morelet*) is the main fungal constraint affecting bananas after varietal reconversion related to Panama disease[3]. BSD is a major constraint on banana production, particularly in wet tropic countries where banana is a staple food crop [4], [5]. Thus, it seems interesting to us to evaluate the impact of the BLSD on the banana varieties encountered in Comoros in the public interest and to contribute to a solution to this problem with this work.

Study Area:

The union of the Comoros is located in the Mozambique Channel in north-west Madagascar and opposite Mozambique (see Fig 1). These four volcanic islands, covering an area of 2,236 km², are: Greater Comoros (or N'gazidja en Shikomori), Anjouan (or Ndzouani), Moheli (or Mwali), and Mayotte (or Maore)([6].

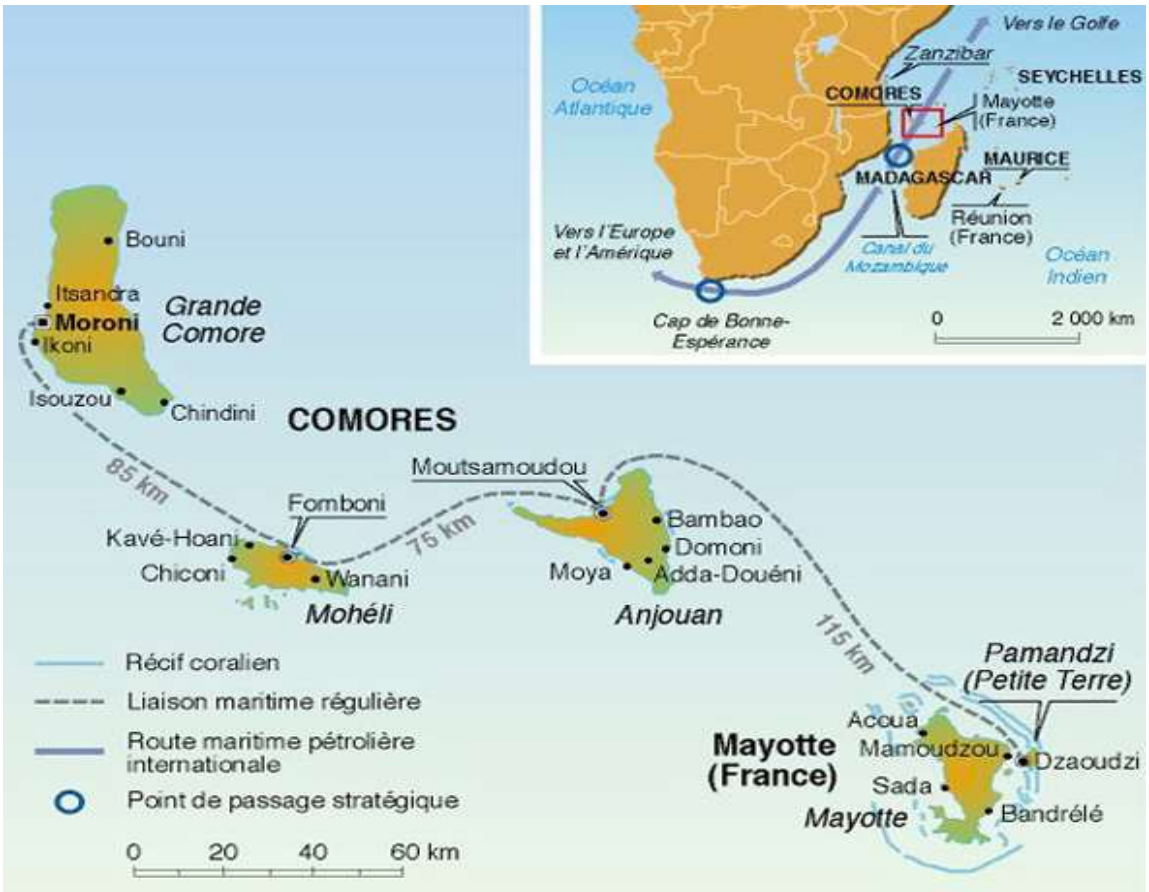

Figure 1: Study area

MATERIAL AND METHODS

To assess the incidence of the disease, we determined the youngest leaf with necrosis (YLN) and the rate of foliar emission (RFE) twhose principles are:

- Youngest leaf with necrosis method

The PJFN method (rank of the youngest leaf with more than 10 necrosis, stage 5-6 of the disease) is relatively simple and fast. It is a good indicator of the health status of a plot (disease intensity) and also provides information on the level of resistance of different varieties. This parameter is defined as the rank of the youngest leaf with at least 10 necrotic spots (stage 5 or 6) or a large leaf blade range necrotized by black cercosporiose (Stover and Dickson 1970; Fouré 1983). The PJFN makes it possible to compare the severity of the disease by the loss of the functional activity of the leaf.

In order to compare different varieties, it is useful to associate with the 'true' PJFN a 'theoretical' PJFN calculated for a leaf emission rate (take a theoretical weekly REF of 1, for example)

- Foliar Emission Rate

At each observation (once a week) we find:

- Last sheet number unrolled

- The cigar stage

It is distinguished 5 stages (0,2, 4, 6,8) of the cigar noted from its appearance until the unfolding of the entire upper part of the blade:We note each week the number of the last leaf formed and the cigar stag e [7].

RESULTS AND DISCUSSIONS

- **Results**

Table 1: banana disease in three Isles

Local cultivar name	Genomic group	Comportement envers DLSD
Isle of Anjouan		
1.Kontrike	AAA (c)	S
2.Koutri	AAA	S
3. Chariah	AAB (a)	S
4.Koja	AAA	RP+
5.Chiwendre	AA ?	To be determined
6.barabahi	ABB	RP
7.Minalouki	AAB	S-RP (confirmed(
8.Zabi	AAB(b)	RP+
9.Nkowa	AA ?	To be determined

Local cultivar name	Genomic group	Comportement envers DLSD
10.Missoukari	AAB	S
11.Nzumoheli nkoboidjewou	AA	S
12.Nzumoheli nkoboindzoukourou	AA	S
13.Trindi mossi	AAA	S
14.Padji	AAA ?	RP(confirmed)
15.Dzumoigne	AAB	S
16.Chicame	AA	S
17.Samba	AA	S
18.Tsounouba	AA ?	S
19.Chicodo	AA ?	S-RP(confirmed)
20.Dimbouni	AAB	RP(confirmed)
Island of Grande Comore		
1.Kontrike	AAA	S
2.Mdzo Djini	AAA	S
3.Paka	AAB	S
4.Barabahi 1	ABB	RP
5. Barabahi 2	ABB	RP
6.Dimba	To be determined AA-AAA ?	S (confirmed)
7.Ikame (Chicame)	AA	S
8.Samba Mugne	AA	S
9.Samba Nkoundre	AA	S
10.Irumbe 1 (vert)	To be determined	To be determined
11.Irumbe 2 (rouge)	To be determined	To be determined
12.Padji Mgazidja	AAA ?	RP
13.Koja	AAA	RP+
14.Djavoulwa Ikoudou	AA	S
15. Djavoulwa djéou	AA	S
16.Issoukari	AAB	S
17.Mossi	AAA	S
18.Gorolo	AAB	RP+
19.Minalouki	AAB	S- RP
20.Ikodo	AA	RP
Island of Moheli		
1.Moubwa	To be determined	S(confirmed)
2.Vountri	AA ou AAB ?	To be determined
3.Siwakubu	To be determined	To be determined
4.Dimba	To be determined	S(confirmed)

Local cultivar name	Genomic group	Comportement envers DLSD
	,AAA ?	
5.Ntsoumouha	To be determined AA,AAA ?	S(confirmed)
6.pimodja	To be determined	To be determined
7.Mouzougou	To be determined	à déterminer
8.Mjanga Mawa	To be determined	To be determined
9.Paka	AAB(c)	S
10.Ndzu Moigne	AAB	S
11.Kontrike	AAA(a)	S
12.Mossi (Trindi Mossi)	AAA	S
13.Barabahi 1	ABB (b)	RP
14.Barabahi 2	ABB (b)	RP
15.Ndzu Mossi	AAB	S
16.Mboidzu	AAB	S
17.Betaloundu	AAB	S
18.Irumbe	To be determined	RP (confirmed)
19.Gorolo	AAB	RP+
20.Samba	AA	S
21.Chicame	AA	S
22.Kissukari	AAB	S
23. « Jolie Banane »	AA	RP
24.Mnalouki	AAB	S-RP (confirmed)
25.Samba Nkundre	AA	S
26.Padji	AAA ?	RP (confirmed)
27.Kouti	AAA	S
28.Doumbouni	AAB	RP (confirmed)
29.Kissukari Mossi	AAB	S
30.Chimwali Marundu	AA(d)	S
31.Chimwali Nkombwandjewu	AA(d)	S
32.Mdzo Djini	AA	S

a),(b) and (c)=varieties in descending order
- Varieties 18, 19, 20, 21, 22 and 23 have been reported in Anjouan.
- Varieties 18 and 19 seen in Grande Comore
- S=susceptible to disease
- RP= partial resistance
- RP+= pronounced partial resistance

- **Les différents stades de la maladie :**

Figure 2: Pictures A,B,C, D& E of different stages of banana disease in the study area

Discussion

After 5 weeks of seeding, the *myceliums* were abundant forming a black colony, from the centre to the periphery of the Petri dish. Microscopic observations revealed the presence of conidia and conidiophores of *Paracercospora fijiensis* anamorph phase of *Mycosphaerella fijiensis* from samples of infected leaves and after isolations (Table 1).

In order to better understand the diversity present in the population of *Mr. fijiensis* of the Union of the Comoros, It would therefore be useful to target another area for the

diagnosis of strain diversity within the species, for example by conducting a study comparable to those of Landry, C. et al (2012), Rivas et al., (2004) or Hayden et al., (2003) using RFLP or PCR-RFLP markers[8]–[10].

Understanding the forces influencing genetic diversity by measuring the spatial scale of their influence is indeed a central task in evolutionary biology [11]. Most varieties show a sensitivity to the disease. The variance analysis did not show any interaction between planting density and NORM control. In addition, only parameters directly related to the health status of the leaves were considered in this study. The incidence of black skate disease on the number of live leaves did not change significantly with planting density for untreated plots. The incidence of black skate disease has been all the more severe as planting density has been high, taking into account of course climatic factors.

Black leaf streak disease

Among the diseases that afflict banana crops, black leaf streak disease (black Sigatoka), caused by *Mycosphaerella fijiensis* Morelet (sexual phase) or *Pseudocercospora fijiensis* (Morelet) Deighton (asexual phase), is the main disease affecting the banana growing worldwide [12], [13]. *Mycosphaerella fijiensis* Morelet is an aerial ascomycete, haploid and heterothallic fungus belonging to the family *Mycosphaerellaceae*[14]. The disease, which is found almost everywhere, is responsible for more than 50% of banana production losses in the world[15].

Also called black Sigatoka, black leaf streak disease is a scourge for banana trees in many southern countries. Caused by the fungus *Mycosphaerella fijensis*, it is characterized by leaf necrosis leading to severe yield losses.

MRN is characterized by the appearance on the leaf of whitish or yellow spots of depigmentation, observable by transparency on the underside of the leaf, which then evolve into dashes 2mm long by 1mm wide and brown-red in color. These lines continue to evolve and become dark brown or black (visible on the upper surface), then widen into an elliptical spot surrounded by a light brown zone [16].

Economic importance of banana

With 110 million tonnes, bananas and plantains are the world's largest fruit production [4], [17]. They are consumed mainly in the form of fresh fruit in the case of dessert bananas, but also in cooked form as is the case with plantains and other cooking

bananas. Dessert bananas for export are mainly made up of a few cultivars from the Cavendish sub-group [18].

In the Comoros, annual production in 2000 was 75,000 tonnes. The banana is present in most of the production systems of the archipelago, it is cultivated up to 1100 m of altitude on all types of soil, extensively, most often in association with other crops. The agricultural sector accounts for 40% of GDP, or 80% of the working population (Comoros Central Bank report).

CONCLUSION

According to this work, it is clear that Black Skate disease remains the major constraint of bananas in the Comoros. Climatic conditions seem to favour the spread of this pathology.

Observations at the plot level helped to assess the incidence of the disease in Mohéli, Anjouan and Grande Comore. The studies thus carried out deserve to be encouraged, better, to be followed. The fight against this disease is essential to ensure the economic exploitation of bananas.

However, the obsolescence of the methods used has not made it possible to determine with precision certain parameters related to the rapid development of *M.Fijiensis* within the archipelago. It is very important, for the success of the operation, to have a strict agronomic monitoring of the hybrids and cultivars on the plots.

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