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**PLANT DISEASE PROBLEMS
IN
BANANA AND PLANTAIN IN HAITI**

by

R. H. Stover

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R. H. Stover¹

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¹ Consultant, La Lina, Honduras. Report completed December 2, 1994.

PWOBLEM MALADI NAN BANNANN AN AYITI

R.H. Stover¹

REZIME

Kat varyete bannann ki pi enpòtan an Ayiti se: Miske ("Plantain"), Fig bannann ("Cavendish"), Fig bayonèt (Silk) ak bannann Poban ("Bluggoe"). Nan tout zòn nou vizite, nou rankontre sou bannann poban yon maladi yo rele mal Panama, men li pi grav nan kèk kote tankou nan Plato Santral toupre Mibalè. Se yon chanpiyon yo rele Fusarium oxysporum f. Ras 2 ki bay plant la maladi sa-a. Bannann poban montre li rezistan kote ki gen lesèk e yo plante li anpil nan zòn sa yo. Yon lòt pwoblèm ki kouran nan bannann ki plante sou kèk tè nan Plèn di Nò, se nematòd nan rasinn plant la, ak pouriti bwa bannann yo. Se Radopholus similis ak Pratylenchus coffeae ki lakòz pwoblèm sa yo. Plantè yo plante pitit bannann ki genyen anpil nematòd. Metòd pou jwenn "semans pwòp" dekri nan rapò sa-a. Lòt pwoblèm ankò, se Sigatoka nan fig bannann Cavendish ak Fig bayonèt Silk ki fè plant yo jete anpil fèy. Se Mycosphaerella musicola ki lakòz pwoblèm sa-a. Lòt varyete natirèl ak atifisyèl ki rezistan kont maladi Panama ak Sigatoka pou ranplase bannann Bluggoe ak Silk te dekri nan rapò-a kòm mwayen pou konbat maladi sa yo. Nouvo varyete miske ta dwe rantre tou nan peyi-a. Yo ka achte tout varyete sa yo nan men konpayi ki pwodwi ti plant ak metòd tisi kilti. Pwoblèm ki rankontre nan bannann ki plante nan tè ajil ki pa pèmèt dlo byen rantre nan tè-a, ak pwoblèm tè ki pa ase gra, te dekri tou nan rapò-a. Pwoblèm tè ki manke gra plis esplike randman bannann yo k'ap bese pase maladi. Yo kapab amelyore tè-a si yo ogmante kantite matyè òganik nan sòl la, swa kite tè-a poze, osnon mete pay ak konpòs nan tè-a.

¹Konsiltant, La Lima, Ondiras

PLANT DISEASE PROBLEMS IN BANANA AND PLANTAIN IN HAITI

R. H. Stover¹

Summary

The four main varieties grown in Haiti are: Plantains (Musque), Cavendish (Figue), Silk (Figue bayonner) and Bluggoe (Poban). Fusarial wilt or Panama disease caused by Fusarium oxysporum f. cubense Race 2 is present on Bluggoe in all areas visited but is most destructive and epidemic in some areas in the central zone around Mirabalais. Bluggoe is drought resistant and predominates in drier areas. Nematode root and rhizome rot caused by Radopholus similis and Pratylenchus coffeae are common on plantain in some fields of the North coastal plain. Farmers are planting heavily infected rhizomes and methods for obtaining "clean seed" are described. Sigatoka, caused by Mycosphaerella musicola causes severe defoliation on Cavendish and Silk varieties. Natural and bred varieties resistant to Fusarial wilt and Sigatoka are described as possible substitutes for Bluggoe and Silk. New bred plantain varieties should also be introduced. These can be introduced as meristem plants from commercial producers. Disorders caused by planting in clay soils of low permeability and by low fertility are described. Fertility problems are causing greater reduction in yield than diseases. Fertility can be improved by increasing the organic matter content of the soil using fallow, mulch and compost methods.

TERMS OF REFERENCE

I was requested to "advise, in the context of Integrated Pest Management (IPM) on pest/disease problems of banana/plantain" in Haiti. A survey of the major problems affecting plant health was carried out from November 15 to November 23, 1994. I was accompanied by Agronomist Fleurantin of

¹ Consultant, La Lima, Honduras.

the Pan American Development Foundation and Agronomist Naval of the Haiti Department of Agriculture. The areas visited were around Leogane, Arcahaie, Cap Haitien and Mirebalais. Visits to Arcahaie and Leogane were only for a few hours. A summary of the survey and recommendations were presented at PADF and USAID November 25.

VARIETIES GROWN

Disease incidence is strongly influenced by the genome or genetic make-up of the plant. Hence, I have listed the varieties grown in Table 1 and illustrated in Figure 1.

For purposes of discussion I will call the French and False horn varieties "Plantains" and the Semi-dwarf and Dwarf Cavendish varieties "Cavendish". Thus, we have four major variety groups: Plantain (Musque), Cavendish (Figue), Silk (Figue bayonner) and Bluggoe (Poban). Plantains predominate in the North coastal plain and in Arcahaie and Leogane followed by Cavendish. Plantains are also important in the Central area but Bluggoe is the main variety followed by Cavendish. Silk is grown in all areas but predominates in the North coffee zone where it is eaten boiled green and ripe. Cavendish is also eaten boiled green more so than ripe.

Silk is shade tolerant according to the coffee growers, and is probably more tolerant of low temperatures. Bluggoe is the most drought tolerant of the varieties and areas planted increase as rainfall declines.

Some of the local names of these varieties are listed in Table 2. Local names change from one area to another and other names probably exist.

CULTIVATION SYSTEM

There are three systems of growing fruit: intensive, home-garden, and extensive or informal.

Intensive.- This involves growing pure stands at populations of 1,500 to 2,000 plants/Ha (Figure 2). It involves plantains and to a lesser extent

Table 1. International varietal names and relative importance in North and Central Haiti.

<u>International names</u>	<u>Genome</u>	<u>North plain</u>	<u>North coffee area</u>	<u>Central area</u>
French plantain	AAB	70	5	10
False horn plantain	AAB	-	-	10
Semi-dwarf Cavendish	AAA	15	5	-
Dwarf Cavendish	AAA	-	-	25
Silk (Manzana) Figue pomme	AAB	5	75	15
Bluggoe	ABB	5	20	40
Gros Michel	AAA	< 5	5	-
Sucrier (Datil)	AA	-	-	-
Red banana	AAA	-	-	-

Notes: A dash (-) indicates uncommon but occasionally observed. Mutants varying in height and pseudostem color are occasionally observed in the Cavendish, Plantain and Bluggoe varieties.

Table 2. Local names for varieties.

<u>International name</u>	<u>Local names</u>
French plantain	Musque (bois blanc, bois noir)
False horn plantain	Musque, Bannann miste
Semi-dwarf Cavendish	Figue gouyate, Figue
Dwarf Cavendish	Figue barik, Figue
Silk	Figue bayonner, Bannann rak
Bluggoe	Matenten, Poban, Grosbute, Massakar
Gros Michel	Gros figue
Sucrier	Figue ravier

Cavendish for sale in the cities. Intensive plantings are found in the coastal plains. There is no fertilization in most fields and yields decline to where replanting is needed after 3-5 crops.

Home-garden.- In areas with adequate rainfall most home gardens have some bananas and plantains. Usually mixed varieties are grown and may be associated with other food crops. These plants often receive house-hold refuse including ashes, and animal manure. If so, plants can remain productive for many years.

Extensive or Informal.- Perhaps 80% of the fruit produced in Haiti comes from this cultivation system. There is no fixed spacing; mixed varieties are common. Plantings are close to roads or trails and most fruit is for home use or local sales. Cultural practices such as weeding and pruning are carried out haphazardly. Plantings are often associated with sugar cane, sorghum, malanga, cassava, yams, cocoa, coffee, citrus or mangos. Yields decline and plants are often moved after the third crop.

DISEASES

Diseases encountered are listed in Table 3.

Panama Disease or Fusarial Wilt (*Fusarium oxysporum* f. *cubense* Race 2).- This disease was found on Bluggoe in the Arcahaie, Cap Haitien and Mirebalais areas (Figure 3). It was most destructive and in epidemic form in the Central zone around Mirebalais. Around Saut D'eau one-half of the plants have died or are infected. In many areas no non-contaminated "seed" (rhizomes) are available and the farmers are spreading the fungus pathogen with infested soil and rhizomes. The Silk variety is susceptible to Race 1 of Fusarial wilt. Apparently this Race is not present in Haiti.

Nematode Root and Rhizome Rot.- This was destructive in some fields in the plains near Cap Haitien on plantains (Figure 4). Plants were stunted and bore small fruit. *Radopholus similis* is the most destructive nematode on plantains followed by *Pratylenchus coffeae*. Fungi invade the lesions caused by nematodes and destroy the roots by invading the stele. A nematode

Table 3. Diseases observed in North and Central Haiti.

<u>PATHOGEN</u>	<u>DISEASE CAUSED</u>	<u>VARIETIES AFFECTED THE MOST</u>
Fusarium oxysporum f. cubense Race 2	Panama disease (Fusarial wilt)	Bluggoe
Radopholus similis	Root and rhizome rot	French plantain, Cavendish, Bluggoe
Pratylenchus coffeae	Root and rhizome rot	French plantain, Bluggoe
Mycosphaerella musicola	Sigatoka leaf spot	Silk, Cavendish, French plantain
Banana streak virus	Mild mosaic on leaves	French plantain, Bluggoe

Notes: A nematode survey is needed to determine the prevalence of Radopholus and Pratylenchus. Rhizome lesions from Bluggoe were examined in Honduras (Appendix 4) and contained Pratylenchus coffeae (most abundant), Radopholus similis and the spiral nematode Helicotylenchus sp. Cordana musae is common on the edges of old Sigatoka spots and along torn leaf edges and is a minor pathogen.

survey by an experienced nematologist is needed to determine species present and the geographic extent of root and rhizome injury.

Sigatoka Leaf Spot or Yellow Sigatoka (*Mycosphaerella musicola*).- This fungus pathogen causes severe defoliation of Cavendish and Silk varieties everywhere (Figure 5). Plantains are resistant but some defoliation can occur in moist micro-climates. Disease incidence is related to rainfall and damage is greatest as the rainfall seasons progress. Some recovery of foliage occurs in dry seasons.

In Central and South America, severe leaf spot causes premature ripening and fingers will turn yellow before the bunch is harvested. Severely defoliated plants in the areas visited did not have a single ripe finger. This suggests the Cavendish varieties in Haiti have some disease tolerance. This is also indicated by the production of 10-12 Kg bunches on plants with almost no healthy leaves. Plantains are highly susceptible to the black Sigatoka pathogen (*Mycosphaerella fijiensis*) which has spread to Cuba from Central America.

Banana Streak Virus.- This virus is common on plantains and bananas worldwide. It can cause loss of fruit on Cavendish varieties where symptoms of leaf distortion and necrosis occur. On plantains, symptoms consist of a mild mosaic which may disappear at certain times. What effect the virus has on plantain yield is unknown. It was detected in the Arcahaie and Cap Haitien areas but is not common. The vector is probably a mealy bug common on bananas. However, I did not find any mealy bugs in the areas visited.

INSECTS

The banana weevil *Cosmopolites sordidus* was most common in the Northern coffee zone. It occurred sporadically in the lowlands on plantains. Damage from tunnelling in the rhizome was insignificant except occasionally on plants growing slowly in compact clay soils. In general, this insect is not an important cause of losses in the areas visited. Red spider was observed on foliage in the Arcahaie area. Damage was insignificant. This insect can cause some transient damage in the dry season.

DISORDERS

Disorders can seriously affect plant health by interfering in the assimilation of nutrients and reducing photosynthesis resulting in poor yield. The major disorders are listed in Table 4.

Compact Soils.- Frequently farmers would show us stunted plants that bore miniature bunches (2-4 hands). In most cases the root system was rotten because the rhizomes were in impermeable clay soils that the roots could not penetrate. Often these soils were saturated with water. We advised them to plant only light clay, loam or sandy loam soils.

Nutrient Deficiencies.- These were widespread and associated with foliage symptoms and small bunches. In the areas visited, nutrient deficiencies are more important in reducing yield than diseases. Nitrogen, potassium and magnesium deficiency symptoms were most common (Figure 6). In West Africa, maintenance of soil fertility for plantains involves bush fallow and mulching. As a result of population pressures fallow time has been reduced from 8-10 years to 2 years or less. Land for growing grass (Elephant, Guatemala, Guinea grasses) for mulching is now scarce. Undoubtedly, fallow times are being reduced in Haiti because of population increase. The response to mulch is indicated by the following figures from Swennen:

<u>Tons per Ha</u>	<u>Control</u>	<u>Fertilizer*</u>	<u>Mulch*</u>	<u>Mulch + Fertilizer</u>
First ratoon	0.6	2.8	10.2	10.4

* 550 Kg K₂O + 300 Kg N/Ha.

* 80 tons per acre of Pennisetum purpureum (elephant grass)

Green manures are also useful in maintaining fertility but according to the Manuel d'agronomie tropicale (see references), green manure is not economic in most parts of Haiti.

Alley cropping has maintained soil fertility for plantains in West Africa. However, it is not popular with farmers.

Grass.- Grass is a major competitor for nutrients and grass bound plantains and bananas had plants with pale-colored foliage and small bunches (3-5 hands). Close spacing (1,700-2,200 plants per Ha) helps to shade out grass.

Table 4. Widespread disorders observed in North and Central Haiti.

DISORDER	CAUSE
Root rot, stunted growth, small bunches	Clay and impermeable soils, unsuitable for bananas
Potassium deficiency	Lack of fertilization, organic matter (mulch, compost)
Nitrogen deficiency	Lack of fertilization, organic matter
Magnesium deficiency	Lack of fertilization, organic matter
Minor element deficiencies Zn, S, Fe	Lack of organic matter, leaching on sandy and gravel soils. Fe deficiency common in calcareous soils
Stunted growth, pale green foliage	Heavy grass growth

Notes: Deficiencies are widespread on all varieties but especially on French plantain and Cavendish which produce more fruit per hectare (larger bunches, faster ratooning).

CONTROL OF DISEASES

The major problem that can be ameliorated by cultural practices is nematode root rot. Practical control of Panama disease and Sigatoka leaf spot involves introducing resistant varieties.

Nematode Root and Rhizome Rot.- As a result of nematodes invading the roots and rhizomes bunch weight is lowered 30 to 60% and the life of the plant is shortened to three crops of declining bunch weight. The planting is then abandoned and seed (rhizomes) dug to plant a "new" field. Unfortunately, the seed planted in the new field is usually heavily infected with nematodes (Figure 4). Removing the roots and peeling the infected rhizome until only white tissue is showing will reduce the nematode population 90%. This operation should be done in the field where seed is being dug. Once peeled the rhizome should not be placed on soil until planted.

A major source of nematode free plants are small meristem plantlets grown to field planting size in a nursery. The larger the number of plants ordered the cheaper the unit cost. These plants cost in the range of 60 cents to 1.50 US dollars depending on volume and nursery procedures. They should be planted in areas that have been free of banana growth for 12 months.

The cheapest but longer approach to "clean" planting material is to establish field plantings in "virgin" soil with meristem plants and use the area as seed-bed, removing suckers for distribution as they reach the optimum size. Also a bag nursery can be established from these areas using "peepers" (young sprouting suckers). Using a combination of these methods, from 20-25 plants can be obtained from each adult plant per year.

Fusarium Wilt or Panama Disease.- There are ABB substitutes for Bluggoe. These are Pelipita, Cardaba and Saba, all from the Philippines and resistant to wilt and leaf spot. In addition, FHIA (Fundación Hondureña de Investigaciones Agrícolas, La Lima, Honduras) has produced an AAAB tetraploid hybrid with Cardaba as the female parent that is resistant to Sigatoka, Fusarial wilt and Moko. Samples of these varieties should be distributed to selected farmers where Fusarium wilt is epidemic for agronomic and organoleptic evaluations assisted by professional agronomists.

Sigatoka Leaf Spot.- FHIA has produced a hybrid tetraploid (AAAB) French plantain named FHIA 21 resistant to leaf spot. In addition, IITA has produced seven new tetraploid varieties of French plantain (see references). All are resistant to leaf spot. FHIA 21 is available commercially as meristem-derived plants (see Appendix 2) and the IITA varieties can be obtained through INIBAP or directly from IITA. FHIA 1 is a Silk-type tetraploid with the slightly acid taste of this variety. It is resistant to leaf spot and all known races of Fusarial wilt. It is available commercially.

There are no leaf spot resistant substitutes for Cavendish varieties and application of fungicides is not recommended and is uneconomic for Haiti. Removal of leaves once they are half destroyed and leaving them on the ground to rot helps to reduce inoculum. This process called "deleafing" is a routine operation in Central and South America for helping control black Sigatoka.

APPENDICES



Figure 1. All four major varieties are present in this fruit unloaded from a Haitian pony for sale at a roadside market.



Figure 2. An intensive cultivation system: 2,000 plants/Ha French plantains on an alluvial river soil near Cap Haitien. The necrotic tissue is Sigatoka leaf spot.



Figure 3. Upper: yellow and dead leaves are the external symptoms of Panama disease (Fusarial wilt) on Bluggoe (Poban). Lower: internal symptoms of vascular necrosis in the pseudostem.



Figure 4. Nematode rhizome and root rot of French plantain near Cap Haitien. Upper: note blackened rotten roots; Lower: rhizome peeled to show reddish brown necrotic areas infected with nematodes and white healthy areas.

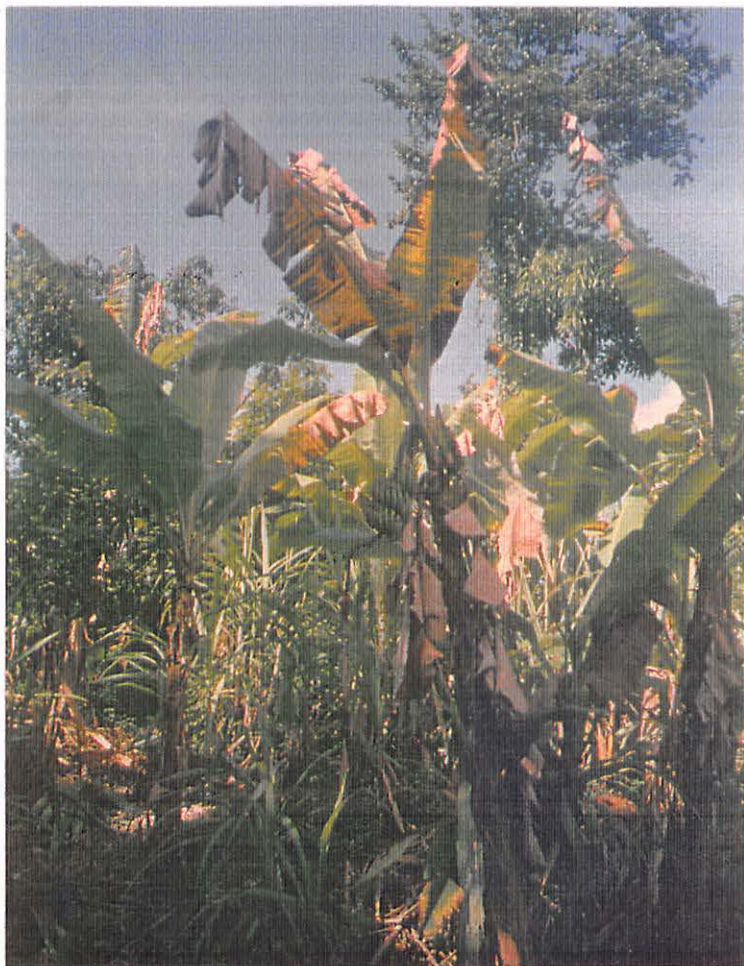


Figure 5. Sigatoka leaf spot on the Silk variety. Often only one healthy leaf is present at time of harvest.

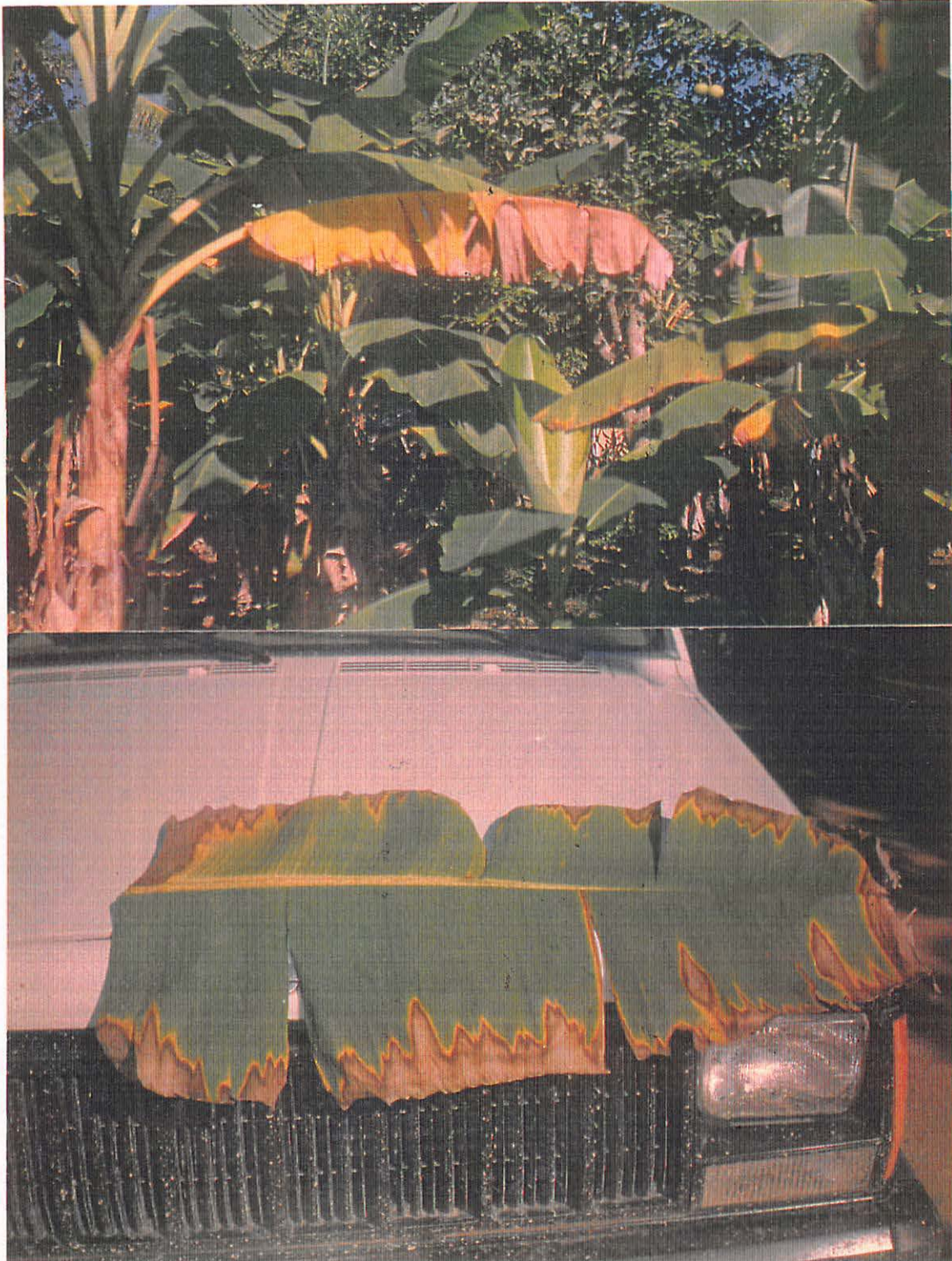


Figure 6. Symptoms of nutrient deficiency are widespread. Upper: potassium deficiency; Lower: magnesium deficiency.

Appendix 2. Commercial Production of Meristem Plants

There are numerous companies producing banana and plantain varieties. The largest companies are in Israel and South Africa. The nearest company to Haiti is in Santiago, Dominican Republic:

Luoma Vitrolab
P.O.Box 318
J. N. Ravelo Nº 1, La Trinitaria
Santiago, República Dominicana
Tel. (809) 581-4334
FAX: (809) 581-3496

The company I am most familiar with is headquartered in South Africa but has a branch operation at La Lima, Honduras. It has an arrangement with FHIA (also in La Lima) to produce new FHIA varieties in exchange for a small royalty. It has an extremely sophisticated nursery grow-out technique in operation in La Lima where it is producing 2 million plants of the Grand Naine variety for Standard Fruit Company (Dole). This technique shortens considerably the time from arrival of meristem plants to the field planting stage resulting in reduced costs. It is also producing and selling FHIA 1, 3 and 21.

Mr. Jeff Parsley, Director
Leeways Laboratory (PTY) Ltd.,
P.O.Box 2379
Tzanen 0850
South Africa
FAX: 015-230-53172

This company produces more than 2 million plants a year in South Africa.

It will be necessary to have a nursery in Haiti to grow-out the small meristem plants after arrival at the Port-au-Prince airport. Do not import plants ready for field planting because of the danger of introducing new diseases in the rooting mix.

The Parsley company will provide technical assistance in setting up a grow-out facility. This could be done in co-operation with a local nursery producing plants for sale in Haiti or export.

Appendix 2 (cont'd)...

I suggest ordering 5,000 plants each of the following varieties mentioned in the report over a 6-8 month period once grow-out facilities are established (smaller volumes can be ordered but the unit cost will be considerably more):

FHIA 1	(Silk type)
FHIA 3	(Bluggoe Poban type)
FHIA 21	(French plantain type)
SABA	} ————— Bluggoe (Poban) types
CARDABA	
PELIPITA	

The actual logistics of the operation should be established by the meristem company.

Appendix 3. Useful References

- INFOMUSA. The International Magazine on Banana and Plantain. Parc Scientifique Agropolis 34397 Montpellier Cedex 5 France (copy given to SECID). Request French edition.
- Manuel d'agronomie tropicale appliquee a l'agriculture haitienne. (copy in PADF library).
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FUNDACION HONDUREÑA DE INVESTIGACION AGRICOLA

DATE: December 1, 1994

TO: Dr. R.H. Stover

FROM: Dr. Gloria C. Molina
Dept. Protección Vegetal

SUBJECT: RESULTS OF DIAGNOSIS

Plant parasitic nematodes detected in sample of banana corm from Haiti.

*Bluggoe
Var.*

Nematodes Detected	Nematode count (25 g corm)
1. <i>Pratylenchus sp coffeae</i>	3205 *
2. <i>Radopholus similis</i>	102 *
3. <i>Trichodorus sp</i>	5
4. <i>Helicotylenchus</i>	18 *
5. <i>Hemicriconemoides</i>	3

The cost of this diagnosis is Lps. 80.00

* Pathogens

GCM/gm
PV.03\Diagnost\Stover

Apartado Postal 2067
San Pedro Sula
Honduras
Tel. (504) 68-2078, 68-2470
Fax: (504) 68-2313