Note technique

Status of Banana Diseases in China

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ABSTRACT - 4 groups of banana cultivars grown in China are Xiang Jiao (AAA), Fen Jiao (ABB), Da Jiao (ABB) and Longya Jiao (AAB).
The major disease problems of banana in China are bunchy top, leaf diseases such as yellow sigatoka, *Macrophoma* freckle and *Cordana* leaf spot, infectious chlorosis, *Fusarium* wilt, nematodes and fruit diseases, in order of their importance.
Bunchy top, sometimes along with infectious chlorosis, is widespread and serious on Xiang Jiao cultivars. Effective measures mainly include growing with virus-free plant materials, rouging, good sanitation and killing aphid vectors in due time. However, this should be expanded by including effective administrative decrees and funding. More rapid and sensitive detection techniques and standard techniques should also be developed for the production of virus-free micropropagated banana plantlets. To screen and breed for resistant cultivars by combining newly-developed biotechniques with traditional banana breeding methods would also be worth strengthening for easy and inexpensive control of diseases.
There have been some reports on major leaf and fruit diseases and control measures have been proposed. However, further understanding of varietal resistance against major leaf diseases such as yellow sigatoka is imperative. A set of effective and practical integrated control measures should be considered, focusing not only on the major leaf diseases but also on some fruit diseases based on current studies on individual diseases.
Fusarium wilt only occurs in limited regions and cultivars. Further study on the disease should include its pathogen race, varietal resistance and measures for preventing its dispersal. Resistance to cold and freeze injury should be essential in new cultivars for subtropical growing areas especially under the changing climate.

Les maladies du bananier en Chine.
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Les cultivars de bananiers cultivés en Chine sont répartis en 4 groupes : Xiang Jiao (AAA), Fen Jiao (ABB), Da Jiao (ABB) et Longya Jiao (AAB).
Les principaux problèmes sanitaires de ce pays sont par ordre d'importance : le "bunchy top", des maladies affectant la feuille (sigatoka jaune, tachetures dues à *Macrophoma* et taches foliaires dues à *Cordana*), des chloroses infectieuses, le wilt causé par *Fusarium*, les dégâts dus aux nématodes et des maladies du fruit.
Le "bunchy top", parfois associé à des chloroses infectieuses, est très répandu et fait de sérieux dégâts sur les cultivars Xiang Jiao. Un ensemble de préventions efficaces consiste principalement en l'utilisation de matériel de plantation indemne de virus, un bon suivi sanitaire et l'élimination, dans les temps, des pucerons vecteurs de maladies. Cependant, ces méthodes seraient améliorées par la promulgation de décrets administratifs efficaces et par l'octroi de financements appropriés. Des techniques de détections plus rapides et plus précises et des techniques standard devraient être aussi développées pour la production par micropropagation de plants de banane indemnes de virus. Le tri et la sélection de cultivars résistants effectués par la combinaison de nouvelles techniques de biotechnologie et de méthodes traditionnelles de sélection du bananier pourraient aussi permettre d'améliorer le contrôle des maladies qui se ferait alors facilement et à coût moindre.
Il y a eu quelques rapports sur les principales maladies de la feuille et du fruit du bananier et des mesures de contrôle ont été proposées. Cependant, une meilleure compréhension de la résistance variétale vis-à-vis des maladies de la feuille les plus répandues, telle que la sigatoka jaune, est impérative. Un ensemble de mesures permettant un contrôle réel et efficace, pourrait être axé non seulement sur ces maladies de feuilles mais aussi sur celles des fruits en se basant sur des études en cours effectuées sur des maladies particulières.
Le wilt dû au *Fusarium* est observé seulement sur certains cultivars et dans des régions particulières. Des études approfondies sur cette maladie devraient porter sur l'identification du pathogène, la recherche de résistances variétales et la définition de mesures permettant de limiter la dispersion de la maladie. Une résistance aux effets du froid et du gel devrait être indispensable pour les nouveaux cultivars destinés à des aires de cultures subtropicales et tout spécialement à celles présentant des variations de climat.

KEYWORDS: China, *Musa* (bananas), plant diseases, banana bunchy top virus, *Cercospora*, chlorosis, anthracnoses, *Fusarium*, *Macrophoma*, plant nematods, research projects.

MOTS CLES : Chine, *Musa* (bananes), maladie des plantes, virus bunchy top bananier, *Cercospora*, chlorose, anthracnose, *Fusarium*, *Macrophoma*, nématodes des plantes, projet de recherche.

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Introduction

There is a long history of banana cultivation in China dating as far back as the Han Dynasty in 200 B.C. At the present time, *Musa spp.* cultivars are distributed in areas from 18° N - 30° N, mainly in the provinces of Fujian, Guangdong, Taiwan, Guangxi, Hainan, Yunnan and Sichuang. It was estimated that banana cropping covers 32 000 ha, excluding Taiwan, and banana yields represent about 2 800 000 tons (LIN, 1990). Most bananas consumed in local and domestic markets, some are exported to Hongkong, Macao, Japan and South Korea.

Commercial Cultivars

In China, people usually classify *Musa* cultivars according to both morphological and economic characters. The important cultivars are classified into 4 groups: Xiang Jiao (AAA), Da Jiao (ABB), Fen Jiao (ABB) and Longya Jiao (AAB). They are all for dessert consumption.

Xiang Jiao (AAA) plays the leading role in China's banana industry. Based on the plant height of cultivars, this group is divided into 3 subgroups: 1. high-type Xiang Jiao, 2. mod-erate-type Xiang Jiao and 3. dwarf-type Xiang Jiao. Subgroup 1 includes Gaojiao Dundilei, Dazhong Gaoba, Qiwei, You Jiao and Bei Jiao. Subgroup 2 includes Dazhong Aiba and Aijiao Dundilei. Subgroup 3 includes Tianbao Jiao, Nalong Jiao, Honghe Jiao and Hekou Jiao. These cultivars are grown in plantations and account for a very large volume of the total national production.

Da Jiao (ABB) cultivars include Gaoba Da Jiao, Zhongba Da Jiao and Fen Da Jiao. They are mainly grown in backyards and therefore only provide a small volume of the total national production. They are more extensively distributed than Xiang Jiao, because of their resistance to chilling injury.

Fen Jiao (ABB) and Longya Jiao (AAB) groups include Fen Jiao and Longya Jiao, respectively. Since they are sensitive to *Fusarium* wilt, they are now grown in limited quantities.

Disease Problems

Some banana diseases were known to occur in China as early as the 1930 - 1950s (PPB, 1959; FRI, 1960; TAI, 1979), but more detailed studies have been carried out recently. The major banana diseases now in China, in order of importance, are bunchy top, leaf diseases especially yellow Sigatoka, infectious chlorosis, *Fusarium* wilt, nematodes and fruit diseases. In this report, disease problems in China will therefore be discussed in this order.

Bunchy Top

Bunchy top was first reported in Zhangzhou, Fujian in 1954 and became epidemic in Guangdong, Guangxi, Yunnan in almost the same period (PPB, 1959; FRI, 1960). The disease was still present and continued to become partially epidemic in the above areas in the 1960s. In the 1970s and 1980s, as banana growing areas were rapidly expanded, a large number of infected suckers were introduced into new banana growing areas. And the disease was then distributed in most areas where Xiang Jiao (AAA) cultivars were grown (HUA, 1989; LI *et al.*, 1988; OU *et al* 1985; SUN *et al.*, 1991; and our unpublished results).

The disease incidence of bunchy top varied from a very low percentage 20 - 30%, to even higher than 70 - 80%, where plantations had to be replanted with banana or other crops. Disease incidence is dependant upon the cultivar type, planting materials with or without BBTV infection, ratooning duration, banana age, vector infestation, cultivation practices, climate, soil and topography. Concerning cultivars, Fen Jiao and Da Jiao cultivars (ABB) were more resistant, usually with very low disease incidence or even free and immune *in vitro* and *in situ*, whereas Xiang Jiao cultivars (AAA) including more than 10 commercial cultivars and some newly introduced cultivars were highly susceptible to BBTV. In diseased areas, infected suckers and micropropagated plantlets are still the major sources of primary infection. Vector infestation and extensive cultivation and therefore accumulation with a large number of diseased plants are the dominant factors responsible for disease epidemics. Other factors including climate, soil, topography and other cultural practices favourable to vector infestation, transmission of BBTV and accumulation of the virus source also contribute to the epidemic (unpublished results).

Annual BBTV incidence markedly varied with seasons and the incidence peak varied with locations. For instance, the incidence peak occurred during April to June in Fuyan, whereas it was reached during May to July in Yunnan (SUN *et al.*, 1991; our unpublished results).

Results of studies on behavior, infestation trends and transmission of *Pentalonia nigronervosa* showed an annual infestation peak which varied with regions, e.g. from September to December in Fujian and around April in Yunnan. Transmission during the peak was responsible for a disease incidence peak occurring some months later, such as between April and June in Fujian.

Control studies showed that planting with virus-free banana seedlings, rouging, good sanitation and killing aphid vectors in due time could effectively check BBTV incidence to a very low level (OU *et al.*, 1985; SUN *et al.*, 1991; ZHOU *et al.*, 1991). These measures are currently being put into effect on a large scale in all diseased areas and still needs strong support from administrative departments, sufficient supply of virus-free planting materials and other coordinating measures and efforts.

Ultrastructural changes of BBTV diseased leaves were examined and spherical particles of about 22-23 nm diameter were often observed (CAI *et al.*, 1989). Studies in our laboratory showed the presence of spherical virus particles about 16-18 nm in some sieve elements. Purification was carried out and an antiserum was obtained by immunizing rabbits with the purified virus preparation with particles of about 18-20 nm diameter. The antiserum has been used primarily for epidemiological studies and banana micropropagation (unpublished results).

Monoclonal antibodies from Su and Wu in Taiwan and antiserum from Thomas in Australia were used for the detection of BBTV-diseased plants (SUN *et al.*, 1990). Detection using 2,3,5-triphenyl tetrazolium chloride according to the methods of Summanwar (1982) was also tried (ZHOU *et al.*, 1991). Our studies indicated that the present antiserum could be used in virus detection (unpublished results). We are also trying to establish a virus-free motherplant nursery for micropropagation purposes by combining several detection techniques such as ELISA, electron microscopy, immunoelectron microscopy and biological methods against BBTV, infectious chlorosis agents and other virus diseases.

Leaf Diseases

Leaf diseases infecting *Musa spp.* were known to occur as early as in the 1930-40s (TAI, 1979) and several leaf diseases were described before 1960 (FRI, 1960). Leaf spot caused by *Cercospora musae* was considered to be the most important leaf disease. *Cordana* leaf spot *(Cordana musae)* and *Macrophoma* freckle *(Macrophoma musae)* were second. These 3 diseases were found everywhere in the banana growing areas of Fujian, Guangdong, Guangxi and Yunnan. They caused early decline and death of a large number of banana leaves in the growing period and had a tremendous effect on banana yield and quality, leading to great losses (FRI, 1960; HUANG, 1985; WANG *et al.*, 1990). It was estimated that only yellow sigatoka could impair 20-40% or even over 80% of the total leaf area in diseased plants and cause yield loss of more than 50% (HUANG, 1985).

Other known leaf diseases included those caused by *Ceratocystis paradoxa, Cercospora musaecola, Deightoniella torulosa, Leptosphaeria musarum* and *Pyricularia grisea,* etc. Some of them were very common, the rest occurred locally with little significance except in certain given areas with particularly favourable microenvironments. For instance, leaf blast caused by *P. grisea* only seriously affected micropropagated seedlings in plastic sheds (WANG *et al.*, 1990).

Severe major leaf diseases occur in the most humid seasons within a given temperature range. Many banana growing areas in Fujian, Guangdong, Guangxi, Hainan and Yunnan situated in north tropical and south subtropical areas with heavy rainfall and high humidity are favourable to the incidence of leaf diseases. Recent increases in planting densities in some plantations, which raised the humidity of the microenvironment, also favoured the disease incidence. The time of disease incidence varied with disease species and locations and depended upon temperature and humidity (rainfall). When the dry season began accompanied by low temperature, the disease incidence dropped.

Presently, measures to control leaf spots mainly include plantation sanitation, such as burning out diseased leaves to reduce infection sources, cultural practices to reduce humidity within the plantation and increase the plants resistance potential and occasional spray of chemicals such as Bordeaus mixture, Carbendazim, Benlate and Thiophanate. However, these chemicals were not commonly used since most banana was cultivated individually on a small scale and individual growers paid little attention to leaf spots. As the farming system and cultural practices change and leaf spots become increasingly important, experts have suggested some measures to check them. They include spraying with chemicals in due time, breeding and screening for well-resistant cultivars or clones from diverse resources and exerting more strict quarantine measures, especially to prevent the introduction of black sigatoka by *Mycosphaerella fijiensis* var. *difformis* and black leaf streak by *M. fijiensis* from abroad and Taiwan (WANG *et al.*, 1990).

Except for these infectious leaf diseases, leaf marginal scorch in some areas and freeze injury in some years or areas have also been considerably severe. Leaf marginal scorch was a new disease occurring in Dongwan and Guangzhou suburban areas, Guangdong and in some areas in Fujian especially near brick and cement factories, with 90% diseased plants, 50-90% diseased leaves. One – fifth to two – thirds of the total leaf areas were found to be infected. Symptoms are characterized by water-soaked chlorotic, or dark green lesions in undeveloped leaves, followed by banded necrosis in waved or ragged form on the leaf margin along the midrib. Diseased parts then stopped spreading and seemed to be greyish white when the leaves were fully developed. It was most severe in the summer and fall. Although there have been many postulations on the causal agent, it is mostly believed to be induced by fluoride and other toxic substances such as carbon monoxide, sulphur dioxide and sulphur monoxide in the microenvironment (WANG *et al.*, 1990).

Freeze injury has also been a problem in subtropical growing areas especially in some particularly severe winters such as 1986 and 1991. In the winter of 1991, temperatures as low as -2 °C locally, which is thought to be the first case in a hundred years, swept through all subtropical growing areas, killing parts of banana plants above the ground by freezing and causing a tremendous loss.

Infectious Chlorosis

Infectious chlorosis was first reported in suburban areas of Guangzhou, Guangdong in 1974 and was later found to be caused by a strain of cucumber mosaic virus (CMV) (KAO and FAAN, 1983). The disease now occurs in many banana growing areas in Guangdong, Fujian, Guangxi and Yunnan (KAO and FAAN, 1983; SONG *et al.*, 1990; ZHANG, 1984; ZHONG, 1988; our unpublished results). The incidence varied from a very low percentage of 10-20%, to even over 90% in some plantations. Our studies in Fujian showed that infected banana plants with traditional sucker propagation methods had less severe symptoms with no apparent stunting. Some plants even contained virus particles detectable by indirect ELISA and biological methods, but showed no symptoms. In contrast, symptoms in diseased micropropagated seedlings were much more severe with apparent, broken or continuous yellow streaking. Certain symptoms became more severe as the plants grew, with some diseased plants even dying, whereas part of the symptoms disappeared. Nevertheless, virus particles were found in symptomless plants (unpublished results).

Investigation of the newly-planted micropropagated seedlings and detection of motherplants for micropropagation

and micropropagated plantlets showed that infection of planting materials especially micropropagated materials was the maior primary source in plantations. Incidence rates increased as the plants grew, so secondary infections were possible.

An attempt to diagnose diseased plants using staining methods with 2,3,5-triphenyl tetrazolium chloride was carried out, as reported by Summanwar (1982) concerning BBTV-diseased plants (ZHOU *et al.*, 1991). More common methods to detect CMV in banana diseased plants include immuno-diffusion, indirect ELISA and immunoelectron microscopy with antisera against other CMV strains or isolates from other hosts and good results have been obtained (KAO and FAAN, 1983; SONG *et al.*, 1990; our unpublished results). We also use these methods as routine procedures in banana plants to detect micropropagation and carry out epidemiological studies.

Control of infectious chlorosis by CMV was believed to be much more difficult than that of BBTV since CMV had a wider host range (SONG *et al.*, 1990; ZHOU *et al.*, 1991). However, our studies showed that CMV infectious chlorosis could be controlled by planting with completely virus-free seedlings and effective rouging, based on the fact that infected planting material was the major primary source of disease incidence.

Fusarium Wilt

Fusarium wilt caused by *Fusarium oxysporum* f. sp. *cubense* now only occurs in some banana growing areas in Guangdong, Guangxi and Hainan, mainly infecting Fen Jiao (ABB) and Longya Jiao (AAB). How and when it was introduced into the areas is not fully known. Although the disease now has little effect on overall banana production in China, it is a potentially dangerous and devastating disease based on the fact that it has caused tremendous losses in many banana areas abroad and in Taiwan and particularly that race differentiation of its pathogen exists. It is therefore strongly recommended that strict quarantine and some other measures be taken into consideration to prevent spread and epidemics of the disease.

Nematodes

It was not until the late 1970s that a systematic investigation on nematodes affecting banana was carried out (FENG *et al.*, 1981; LI *et al.*, 1987; LI, 1991; YIN *et al.*, 1982; ZHANG *et al.*, unpublished).

In Fujian, root-knot nematodes were widely distributed in all types of banana growing areas with a high infection rate, causing obvious root-knot symptoms. The known species included *Meloidogyne javanica, M. arenaria, M. incognita* and *M. megadora,* with the former two being dominant. Eighteen other nematodes affecting banana have also been isolated and identified (Zhang *et al.*, unpublished).

In Guangdong and Hainan, *Rotylenchus reniformis* was reported to be the most common species affecting banana, causing great damage to the root system, while root knot nematodes, *Meloidogyne spp.*, could cause serious banana yield losses. *Helicotylenchus spp.* were believed to be closely associated with the decline of banana plantations. Over 20 other genera (species) were also isolated and / or identified (LI *et al.*, 1987; LI, 1991; YIN *et al.*, 1982).

In Guizhou, 19 genera and / or species were isolated and / or identified on plantain (FENG *et al.*, 1981). There have been no reports on nematodes in Guangxi and Yunnan.

The burrowing nematode, *Radopholus similis,* that causes a serious problem in most banana growing countries, has not been found in China. However, it was detected on a batch of introduced banana planting materials at the customs Quarantine Institute (LIN, 1991) and decisive measures were adopted to treat the materials so as to kill the nematode.

Exact nematode-caused banana yield losses are unclear and thus little attention is paid to control.

Diseases Associated with Fruits

The most important diseases affecting fruits are anthracnose, *Fusarium* crown rot and *Macrophoma* freckle. Reports available at the present time show that anthracnose and *Macrophoma freckle* are distributed in all banana growing areas, whereas *Fusarium* crown rot has only been investigated in detail in Guangdong (HUANG, 1985; LI *et al.*, 1989; LIU *et al.*, 1990; WANG, 1989; WANG *et al.*, 1991).

Anthracnose became epidemic and caused severe losses mostly on yellow-ripe summer and fall fruits and occasionally on green fruits. It was reported to be caused by *Colletotrichum musae* (WANG, 1989; LIU *et al.*, 1990). The pathogen was also recently reported to show strain differentiation (LIU *et al.*, 1990; WANG, 1989).

Fusarium crown rot was reported to be mainly caused by *Fusarium semitectum, F. moniliforme, F. moniliforme* var. *subglutinans* and *F. dimerum.* Its occurrence was closely associated with wounds and injuries in the process of conventional picking, packing, transportation and marketing. High temperature and humidity in transportation carriages or compartments were highly favourable to disease incidence (WANG, 1989; WANG *et al.*, 1991).

When *Macrophoma* freckle infects fruits, it mainly affects fruit appearance and reduces fruit quality and storage potential. Its pathogen is *Macrophoma musae* (WANG, 1989).

Diseases affecting fruits also include finger rot by *Botrydiplodia theobromae,* acid rot by *Geotrichum candidum,* freeze injury and toxicosis by carbon dioxide and so on, which have been occasionally important (WANG, 1989).

Briefly, diseases affecting banana fruits both preharvest and postharvest are becoming increasingly significant. It has been recommended to control diseases by preventing them before harvest, especially directed against anthracnose and *Macrophoma* freckle, treating postharvest fruits properly, improving conventional technology of picking, packing, transportation and marketing under a set of banana commercial production measures and simplifying storage and transportation chains.

Research Needs

There has been considerable work on diseases infecting banana in China and some suitable management strategies were developed and partially adopted. But substantial work is still needed to solve the major banana disease problems. They are grouped as follows:

Checking Bunchy Top and Infectious Chlorosis

Bunchy top, sometimes along with infectious chlorosis, is considered to be very common in banana. Some effective measures have been developed, but these diseases have not been checked and are still causing great losses. These measures are being improved and expanded by further administrative decrees and funding for all needed areas so as to suppress losses caused by the 2 diseases.

Infected plant materials are the primary sources of diseases. There have been several factories established to produce micropropagated banana plantlets on a large scale to meet with banana production needs, but there is a lack of confirmed virus-free resources to provide factories with explants. Therefore, while available detection techniques are being applied and improved for more rapid and sensitive detection of this aspect, a national maternal plant nursery or an equivalent confirmed virus-free source should be established to provide all explants for micropropagation.

Since there were abundant cultivar resources with diverse genetic backgrounds, it was also necessary to screen and breed resistant cultivars, especially by combining some newly-developed biotechniques with traditional banana breeding methods to satisfy future disease control needs.

In addition, the relation between CMV isolates in diseased banana plants and those on other natural hosts, such as crops and weeds, remains unclear. It is also not clear whether more severe incidence in micropropagated plant materials than in conventionally-propagated suckers is determined by the fact that micropropagated plantlets are more susceptible. Whether there is any difference between isolates from various banana growing areas is also unknown. Basic investigations on these problems should also be carried out to reach a better understanding of CMV epidemiology on banana.

Checking Leaf Diseases

Diseases of leaves and their pathogens have been reported in most banana growing areas, but further studies are required in other areas, especially on new local diseases and their incidence trends.

Banana resources are diverse and abundant in China, but their resistance especially against yellow sigatoka needs to be further investigated so as to improve direct disease control and resistance breeding.

Studies on individual leaf diseases, especially the major ones, have been carried out and control measures proposed. However, several diseases commonly occur spontaneously or in series, it is therefore necessary to carry out further studies to define a set of practical and effective integrated control measures against widespread major diseases such as yellow Sigatoka, *Cordana* leaf spot, *Macrophoma* freckle and/or some locally significant diseases such as leaf marginal scorch. For this purpose, screening and breeding for well resistant cultivars or clones especially against yellow sigatoka should again be emphasized.

Preventing Epidemics of *Fusarium* Wilt

Fusarium wilt is now occurring in limited areas and cultivars, but its race type and relation with cultivars are not clear. Above all, it is urgent to understand epidemiological trends and factors and provide a set of measures for control in diseased areas and for prevention in disease-free areas.

Other Needs

There are more than 20 species of banana. It is essential to understand their economical importance in banana production and to provide a set of control measures if necessary.

Diseases affecting fruits are becoming increasingly important as the banana industry develops more commercially. Some measures have been proposed and partially adopted, but infection sources of postharvest diseases mainly come from pre-harvest stages, so means to coordinate control measures for both leaf diseases and fruit diseases should also be considered.

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Las enfermedades del banano en China.

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Los cuatro grupos de cultivares de bananos cultivados en China son Xiang Jiao (AAA), Fen Jiao (ABB), Da Jiao (ABB) y Longya Jiao (AAB).
Por orden de importancia, los principales problemas sanitarios de este país son : el "bunchy top", enfermedades de la hoja (la Sigatoka amarilla, las manchas debidas al "*Macrophoma*" y las manchas de la hojas debidas al "*Cordana*"), clorosis infecciosas, el Wilt causado por *fusarium*, los daños debidos a los nemátodos y a las enfermedades de la fruta.
El "bunchy top" a veces asociado con clorosis infecciosas, es muy propagado y ocasiona daños importantes en los cultivares Xiang Jiao. Un conjunto de prevenciones eficaces consiste principalmente en la utilización de material de plantación indemne de virus, un buen seguimiento sanitario y la eliminación de los pulgones vectores de enfermedades. Sin embargo, estos métodos serían mejorados por la promulgación de decretos administrativos eficaces y por la concesión de financiaciones apropiadas. Unas técnicas de detección más rápidas y precisas y técnicas standard también deberían ser desarrolladas para la producción por micropropagación de plantas de banano indemnes de virus. La selección de cultivares resistentes efectuados por la combinación de nuevas técnicas de biotecnología y de métodos tradicionales de selección del banano podrían también permitir mejorar el control de las enfermedades volviendolo entonces más facil y de menor costo.
Hubieron algunos informes sobre las principales enfermedades de la hoja y del fruto del banano y medidas de control fueron propuestas. Sin embargo, una mejor comprensión de la resistencia varietal frente a las enfermedades más esparcidas de la hoja, tal como la Sigatoka amarilla, es imperativa. Un conjunto de medidas eficaces, y un control integrado realizable, podrían ser dirigidos no sólo contra las enfermedades más importantes de hojas pero también sobre las de los frutos, basandose sobre estudios en curso efectuados sobre enfermedades particulares.
El Wilt debido al *fusarium* se observa solamente en ciertos cultivares y en regiones particulares. Unos estudios profundizados sobre esta enfermedad deberían tratar la identificación del patógeno, la investigación de resistencias varietales y la definición de medidas que limiten la dispersión de la enfermedad. Una resistencia a los efectos del frío y del gel debería ser indispensable para los nuevos cultivares destinados a áreas de cultivo subtropicales y especialmente a los que presentan variaciones de clima.

PALABRAS CLAVES : China, *Musa* (bananos), enfermedades de las plantas, copo racimoso del plátano, *Cercospora*, clorosis, antracnosis, *Fusarium*, *Macrophoma*, nemátodos de las plantas, proyectos de investigación.