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COMMITTEE ON COMMODITY PROBLEMS

JOINT MEETING OF THE FOURTH SESSION OF THE SUB-GROUP ON BANANAS AND THE FIFTH SESSION OF THE SUB-GROUP ON TROPICAL FRUITS

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MAJOR DISEASES OF BANANA AND PLANTAIN: AN UPDATE OF THEIR SPREAD, IMPACT AND RESPOSE STRATEGIES

I. INTRODUCTION

1. The spread of major banana and plantain diseases has escalated dramatically over the past few decades and their control is central to the successful production of these fruits. In recognizing the significance of the problem, in particular the increasing cost of control and the erosion of the grower's profit margin, the Sub-Group on Bananas requested that the impact of banana diseases on farmers' income levels be examined. Before an attempt can be made at analyzing the economic impact of the diseases at farm gate and along the supply chain, a better understanding of the diseases in question needs to be developed, including their geographical distribution, and their importance in the context of crop husbandry and management.

2. This document has been prepared in collaboration with Bioversity[1]. As a first step, it was considered prudent to use the existing technical information on disease occurrence and severity to provide a baseline of the current disease situation and outline the requirements to carryout further analysis. However, obtaining the information necessary to conduct a meaningful impact assessment proved to be extremely difficult, and would require additional resources to generate information through surveys, data acquisition etc. Therefore, the next step in this exercise should be to obtain external funding to collect the necessary information from a cross section of banana growers in Africa, Asia and Latin America and the Caribbean. Delegates are requested to review the document and decide whether a proposal for CFC funding to conduct the assessment be developed.

[1] Commodities for Livelihoods Programme, Bioversity International, Montpellier, France

3. This document provides a brief update on the distribution of four major disease problems, affected cultivars and genotypes and examples of their impact on consumption and trade. A presentation by Bioversity will complement this document.

II. BANANA AND PLANTAIN PRODUCTION BY REGION AND PRIMARY DISEASE PROBLEMS

4. Bananas and plantains are grown in over 120 countries around the world. However, production is concentrated in the tropical, rain-fed regions of Africa, Asia and Latin America (Table 1). The demise of the banana due to disease threats has been an on-going issue, in spite of highly competitive international markets often bordering on over-production. Diseases do represent a serious and expanding threat, as a result of the movement of contaminated plant materials, changes in production technology and changing climatic conditions, to both small-holder banana producers and export production.

5. Of the four major diseases, Fusarium wilt[2] and black leaf streak (BLS)[3] are the most widespread. Banana bunchy top disease (BBTD) caused by bunchy top virus is widespread in Asia and the Pacific and is spreading in Africa. Bacterial wilt[4] is most common in Latin America, while the bacterium X*anthomonas campestris* pv. *musacearum* has recently emerged as a serious threat in East and Central Africa. Bacterial wilts are also spreading within and among a few countries in Asia.

Table 1: Banana and plantain production (thousands of tons) and diseases by region

(Production data – Lescot 2008; disease presence from diverse sources)

Region	Principal types of bananas and plantains				Principal diseases
	Cavendish	Other dessert types	Cooking banana (ABB, AAA EAH)	Plantain	
Latin America	17,714	5,247	849	6,742	BLS, Foc races 1, 2, *Ralstonia*
Caribbean	1,302	301	597	939	BLS, Foc races 1, 2, *Ralstonia*
Mediterranean	1,713	7	8	-	BLS, BBTD, Foc races 1, 2
East/South Africa	1,810	737	13,370	1,275	*Xanthomonas*, Foc races 1, 2, BBTD, BLS
West/Central Africa	2,729	536	1,140	9,002	BBTD, BLS, Foc races 1, 2
Asia	20,625	5,440	10,010	834	BBTD, Foc TR 4, BLS, Foc races 1, 2, *Ralstonia*
Pacific	316	65	543	1	BBTD, BLS, Foc races 1, 2
Total	46,212	12,338	26,520	18,795	

[2] caused by *Fusarium oxysporum* f. sp. *cubense* (Foc). Foc races 1 and 2 occur virtually worldwide, while Foc Tropical Race 4 is still confined to countries in Asia.

[3] caused by *Mycosphaerella fijiensis* occurs virtually worldwide.

[4] caused by *Ralstonia solanacearum* phylotype II

A. FUSARIUM WILT (FOC)

6. The primary challenge to tracking the spread of Foc is the genetic characterization of the races and strains. Strains are identified by VCG (vegetative compatibility group) analysis. They are grouped into 4 races, based on host specificity[5] and their distribution is shown on Table 2. Very few areas are considered free of races 1 and 2, while the spread of tropical race 4 represents a much greater threat, since over 80 percent of the bananas and plantains produced worldwide are susceptible, including commercial Cavendish cultivars, other dessert bananas from diverse genotype groups, the plantain subgroup, and cooking bananas.

Table 2: Distribution of *Fusarium oxysporum* f. sp. *cubense* by region

	Sub Saharan Africa	Latin America/ Caribbean	Asia/ Pacific
Foc TR 4	South Africa (VCG 0120)	Absent	Indonesia, China, Taiwan, Malaysia, Philippines, Australia
Other Foc	No countries free	No countries free	No countries free

7. The presence of races 1 and 2 continues to have a negative impact on the diversification of banana exports and greater diversification of national markets. Attempts to re-introduce Gros Michel as an export banana and to intensify the production of Silk banana in Latin America have been limited by losses to Fusarium wilt. The disease is also a major concern of small farmers in Eastern and Central Africa where Gros Michel is the preferred dessert banana and beer bananas (ABB) provide both food and income. Race 4 is a greater threat to banana and plantain consumption and trade. In spite of an innovative research and development effort, the banana industry in China, Province of Taiwan shrank from over 50 000 hectares to just 6 000 hectares over a ten year period, due at least in part to race 4. The presence of Foc TR4 in Indonesia and Malaysia has prevented the establishment of an export banana sector during a period when the neighboring Philippines has grown to the second leading banana export country with over US$400 million in export earnings. Since the early 2000's when Foc TR4 first appeared in China, over 65 000 hectares or about 25 percent of the total production area have been affected and the disease continues to spread. In 2005 Foc TR4 was reported in the Philippines, first in the highlands, but more recently in a major production area. Losses are still sporadic, but potential losses are very high, depending on the effectiveness of industry response and of emerging practices to limit the spread of the disease.

B. BLACK LEAF STREAK (BLS)

8. BLS has nearly completed its expansion around the globe since it was first detected in the early 1960's. Very few countries remain free of the disease in 2009 (Table 3). Dry and high altitude production areas are less favorable for disease development, although this comparative advantage may be lost either through climate change or the adaptability of the pathogen which has been found at increasingly higher altitudes with time.

[5] Race 1 is detrimental to cultivars from the Gros Michel, (AAA), Silk subgroup (AAB) and Pome subgroup (AAB), while race 2 affects primarily ABBs.

Table 3: Presence of BLS by country/region.

Sub Saharan Africa	Latin America/ Caribbean	Asia/ Pacific
No countries free	Present in all countries, but French Antilles, Argentina, Paraguay	No countries free

9. When BLS initially reached new production areas, yields often declined and some growers abandoned production. Currently losses to BLS and costs of control are part of the status quo. For plantains (AAB) and dessert bananas (AAA), estimates of losses range from 20-70 percent, in the absence of fungicides, depending on the production cycle, the climate and management practices applied. The ABB subgroup and a few other cultivars are partially to highly resistant and do not experience these yield losses.

10. In the case of banana production for export, a survey of countries by the working group associated with the Pesticide Reduction Plan for Banana (PRPB) indicated that fungicide use for the control of BLS had increased in recent years due to regulations on certain types of fungicides and the development of pathogen resistance to fungicides. In Belize since 1995, the number of applications has increased from 44 to 66 applications per year. In Cameroon in the same period the increase has been from 22 to 35 applications. Consumer pressure about the environmental impacts of banana production is likely to increase and alter the current distribution of production areas. Producers in areas with agro-climatic conditions less favorable for disease development will be able to meet the challenge of pesticide reduction more readily.

C. BANANA BUNCHY TOP DISEASE (BBTD)[6]

11. Bunchy top is the only *Musa* disease among the 100 worst alien invasive species. It is present in over 20 countries in Asia and the Pacific and 11 countries in Central Africa (Table 4).

12. Perhaps even more important than the list of countries is the distribution within country. Local surveys are notably uncommon after the disease is reported. BBTD has been present in the Rusizi Valley of Central Africa since 1959, having been introduced in infected suckers from Kisangani, DR Congo. A recent survey carried out by the Consortium for Improving Agriculture-based Livelihoods in Central Africa in five regions in Burundi, Rwanda and the DR Congo highlighted a 25 percent incidence of BBTD and a 45 percent occurrence of its vector.

Table 4: Distribution of BBTD by country/region.

Sub Saharan Africa	Latin America/ Caribbean	Asia/ Pacific
Burundi, Rwanda, Zambia, Malawi, Democratic Republic of Congo, Angola, Cameroun, Central African Republic, Congo-Brazzaville, Gabon, Equatorial Guinea	absent	American Samoa, Australia, Bangladesh, Cambodia, China, Fiji, Guam, USA (Hawaii), India, Indonesia, Kiribati, Malaysia, Japan (Ogasawara-gunto), Pakistan, Philippines, Samoa, Sri Lanka, Taiwan, Thailand, Tonga, Tuvalu, Vietnam, Wallis

[6] Caused by *banana bunchy top virus* (BBTV)

13. BBTD is readily expressed in Cavendish types and other AAA dessert cultivars. ABB cooking bananas show symptoms of BBTD less readily and may be relatively more resistant.

14. The devastating impact of BBTD for small holder production or where virus-free planting material is not available has been demonstrated in both Asia and Africa. In Pakistan production areas were reduced by 55 percent in a single year and incidence was as high as 100 percent in some fields. In other cases, the observed impact is qualitative, clearly evident to scientists and local growers, although not converted to numbers. In the Philippines BBTD eliminated the small-hold Lakatan banana industry of Northern Philippines and production shifted to larger plantations in the southern part of the country. Malawian banana scientists have recently conducted informal reconnaissance of BBTD in regions suffering the outbreak in 1994. They found that in Nkhata-bay district, which is the main supplier for the commercial city of Mzuzu, production has tremendously gone down. The bananas are very scarce and the few, which are available on the market, are mostly of poor quality and expensive. In Masende, a village in Bas Congo, DR Congo, with over 200 families, bunches sold per month declined from 2000 before BBTD to 30 after the spread of BBTD.

D. BACTERIAL WILTS[7]

15. Several different bacteria are responsible for losses due to bacterial wilt. From a few initial sites the disease spread to other locations, now reported present in 20 countries (Table 5).

Table 5: Distribution of Bacterial wilts by country/region.

	Sub Saharan Africa	Latin America/ Caribbean	Asia/ Pacific
Ralstonia bacterial wilt	Senegal, Nigeria	Belize, Brazil, Colombia, Costa Rica, Dominican Republic, Venezuela, El Salvador, Grenada, Guatemala, Guyana, Honduras, Jamaica, Mexico, Nicaragua, Panama, Peru, St. Vincent, Surinam, Trinidad & Tobago, USA (Florida)	Indonesia, Malaysia: Blood disease Philippines: Moko and Bugtok
Xanthomonas bacterial wilt	Ethiopia, Uganda, Rwanda, Kenya, Tanzania, eastern Democratic Republic of Congo	Not present	Not present

16. In ABB cultivars they are primarily vectored by insects which are attracted to the sugary sap found on male flower bract scars. When the bacterium is present in the sap, it can be moved mechanically from sick plants to healthy plants. All cultivars are susceptible to the bacterial wilts when contaminated hand tools are used to prune healthy plants. This is a serious problem both for small holders and in large export plantations.

17. The spread of bacterial *Xanthomonas* wilt in Mukono District, Uganda, one of the first regions to be affected, illustrates the impact of the disease. The area cultivated with banana declined by 40 percent with a reduction in production between 65 and 80 percent reported by 97 percent of respondents. Labor needs to produce bananas declined by 70 percent. The volume of bananas marketed was reduced by 75 percent, while income from juice and banana alcohol declined by 50 percent. The number of traders has also gone down by 50 percent or more.

[7] *R. solanacearum*, *P. solanacearum* and *X. campestris* pv. *musacearum*

Projections suggest that, in the absence of resolute action, cumulative losses of banana production could mount to over US$4 billion by 2010.

III. INTERNATIONAL RESPONSE

18. Numerous organizations internationally and regionally are responding to the threat which diseases of banana and plantain represent for food security and income. These include mobilizing stakeholders to coordinate action plans.

19. A multi-institutional banana disease management framework has recently been proposed for Sub-Saharan Africa covering bacterial wilts and BBTD, but could also include Foc. Public and industry stakeholders in Latin America were convened by OIRSA, a regional plant health agency, to mobilize public awareness, surveillance and quarantine to reduce the risk of disease introduction into the Western Hemisphere. The working group for the Pesticide Reduction Plan in Banana reviewed the elements for short, medium and long term approaches to more sustainable pest and disease management with stakeholders from the public and private sector, civil society and growers in a workshop in late 2007 and is currently formulating proposals for pilot site testing. *Musa* scientists working on Fusarium wilt met in China in mid-September through ProMusa to discuss a research and action plan, including an expanded baseline survey of VCGs globally and the establishment of an international collection. Collaborative research efforts are also being undertaken.

IV. CONCLUDING REMARKS – FINAL OBSERVATIONS

20. All four disease problems described here merit far greater investment in public awareness, basic and applied research, and farmer training and production services to growers. However, limited resources to address multiple problems have been the major constraint.

21. The most basic information needed is a map of banana production areas with accompanying information on numbers of growers and their socio-economic characteristics. Bioversity and IITA recently have begun an informal mapping exercise based on expert opinions from national scientists. An IFPRI project has also been mapping banana production areas as part of a global mapping effort of 22 crops. These preliminary maps in combination with agro-climatic overlays and overlays of the distribution of pests and diseases can then be used to identify which growers will benefit from alternative investments in research and development. Similarly ex ante impact analysis can be done on the types of growers benefiting from investments. The global commitment to the Millennium development goals make such a planning capacity a basic tool for FAO, the international centers working on *Musa* and national programs.

22. To assist the mapping effort and to generate information for economic impact analysis, the Sub-Group may wish to approve an initiative for CFC funding to carry out these activities and produce the analysis for the next session of the Sub-Group.