

Fusarium wilt threatens livelihoods of banana farmers in Southern China



(Top) Field infestation of Fusarium wilt in a Cavendish plantation in Southern China; (bottom) Dr. Molina, Asia-Pacific Regional Coordinator of Bioversity International (in cap), Dr. Yi Ganjun, Director of the Pomology Research Institute of GDAAS (3rd from left), and other researchers and banana growers during a recent field visit and discussions in Zhongshan District where GCTCV 119 is evaluated and showing high resistance to *Foc* TR4.

Agricultural surveys conducted as part of a comprehensive study on the status of banana production in China and commissioned by the national government in 2005 show that banana is grown on an estimated 269 000 ha in the country, with a production capacity of about 6.39 million MT. According to the same study, the banana industry provides about three million jobs for the local people. However, their main source of livelihood is being threatened by the occurrence of Fusarium wilt, currently considered to be the biggest and most important disease especially in the Cavendish-producing areas of Guangdong Province—South China. Also called Panama wilt, the disease is caused by *Fusarium oxysporum* *f.sp. cubense* (*Foc*), a hardy soil-borne pathogen that stays in the soil for a very long time. Although *Foc* Race 1 is believed to have been in China earlier, its presence was only officially reported in 1996. In 1999, some severe incidences of Fusarium wilt were observed in the Panyu District and Zhongshan City, along the Pearl River Delta. *Foc* samples gathered from infected plants in the area were identified to belong to VCG 1213/16, the VCG associated with Tropical Race 4 (TR4) of Fusarium wilt which is causing epidemics in plantations in Malaysia and Indonesia. Tropical Race 4 is a more virulent strain of Fusarium wilt that is considered to be economically-important because they attack and damage Cavendish, which comprise about 90% of the banana industry in South China. By 2006, the disease has rapidly spread and has infected about 6700 ha of banana-growing areas. *Foc* TR4 has also been seriously attacking plantations of the popular local variety 'Fenjiao' (ABB, Pisang Awak). According to the study, Fusarium wilt incidence is concentrated in the Pearl River Delta of Guangdong Province, although there as still no reports on

the extent of the disease in other provinces. But one thing is definite: the disease is putting in peril the livelihoods and welfare of countless banana farmers and workers and the people who depend on them.

The study also found that in China, *Foc* is usually spread via river or irrigation water (i.e., in some places, both irrigation and drainage water run in the same ditches), contaminated farming tools, diseased seedlings or on the wheels of vehicles used to transport bananas. Some banana farmers also unknowingly carry the *Foc* pathogen at the soles of their footwear as they move from Fusarium wilt-infected farms to clean ones. In one case, some farmers from the Panyu and Zhongshan district, known *Foc* "hot spots", rented land in Zhuhai and other district to plant bananas. Some of these farmers brought along planting materials from infected mother plants, therefore taking with them the pathogen to these previously *Foc*-free areas.

Despite repeated government advisory to the contrary, farmers still plant bananas in fields where the incidence of Fusarium wilt exceeds 50%. To help contain the spread and incidence of *Foc*, agricultural RD&E agencies have suggested various measures including crop rotation (with paddy rice or lotus), application of fungicides, and use of organic fertilizers. However, these practices have had very limited effect and were generally too costly for farmers to adopt on a regular basis.

In an effort to stem the advance of Fusarium wilt, various government agencies such as the South China Agricultural University (SCAU) and the Guangdong Academy of Agricultural Sciences (GDAAS) has been conducting extensive research on banana pest and disease

management strategies, which includes, among other things, the identification and screening of banana cultivars that are highly-resistant or tolerant to *Foc* TR4 under small-scale and plantation-type conditions. These studies are being undertaken in collaboration with Bioversity International.

Starting in 2003, GDAAS and Bioversity International have been evaluating improved varieties through the International Musa Testing Programme (IMTP), which includes Fusarium-resistant varieties. Twenty-one varieties were introduced from Bioversity's International Transit Centre (ITC) through the Pomology Research Institute of GDAAS and SCAU, which serve as the National Repository Centre of China. These varieties have also been sent to the China Academy of Tropical Agricultural Science (CATAS) in Hainan Island, South China.

Preliminary field evaluation showed that some introduced varieties are highly resistant to *Foc* TR4. These include FHIA01, FHIA02, FHIA03, FHIA18, FHIA25 and GCTCV119. Of these varieties, GCTCV119, a Cavendish somaclonal selection from the Taiwan Banana Research Institute (TBRI), may prove to be the most useful in China since it is a Cavendish variety. The only shortcoming of the variety is its slightly longer maturity period compared to the popular local Cavendish cultivars. However, further selection and improvement of GCTCV119 may offset this. In a recent visit to Zhong Shan and Guangzhou, Guangdong province, Dr. Agustin B. Molina, Asia-Pacific Regional Coordinator of Bioversity's *Musa* Programme, noted the very good resistance of GCTCV119 in severely *Foc*-infected expanded field trials. In the future, GDAAS aim to select an improved version of GCTCV119 through further somaclonal selections in the field. – with reports from **Chen Houbin, Hu Guibing and Xu Chunxiang**, Tropical and Subtropical Fruit Research Laboratory, South China Agricultural University, Guangzhou, China; **Yi Ganjun, Huang Bingzhi and Xu Linbing**, Pomology Research Institute, Guangdong Academy of Agricultural Sciences, Wushan, Guangzhou, China; and **Agustin B. Molina**, Bioversity International. ■

Fighting Fusarium Wilt in Asia-Pacific

Preparing for the field trials: Farmer participatory workshops in Indonesia



In preparation for the establishment of banana demonstration plots (demoplots) for the field trials in Indonesia, Bioversity International, in cooperation with its country project partners' the Indonesian Tropical Fruits Research Institute (ITFRURI) and the Assessment Institute for Agricultural Technology (BPTP), organized and conducted participatory planning workshops with local banana farmers and farmer groups in its project sites in Lampung, South Sumatra (Sukamaju village, Kedondong sub-district) and in Malang, East Java (Srimulyo village, Dampit sub-district) on 28-31 May 2007. The participatory workshops were carried out as part of the ACIAR-funded project on mitigating the threat of Fusarium wilt in Asia and the Pacific and were facilitated by Dr. Agustin B. Molina, Regional Coordinator of Bioversity's *Musa* Programme in Asia-Pacific; Jeffrey T. Oliver, Communications Officer of Bioversity's Philippines Office; Mr. Bob Williams of the Queensland Department of Primary Industries and Fisheries (QDPI&F); and Mr. Agus Sutanto of ITFRURI.

The workshops aimed to gather baseline information on the demography, cultural/agricultural practices and pest and disease management strategies of banana farmers in the communities, particularly for Fusarium wilt. The activity also familiarized the

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(Top) Dr. Agustin B. Molina discussing some points about the field trials with the farmers of Sukamaju village; (bottom) showing pictures of different banana varieties to some members of the Srimulyo CBO.

farmers about the project, specifically the establishment of the demoplots, which would field-test the package of best-bet Fusarium wilt disease management technology to be developed and deployed by the project. Aside from the farmers, the workshops also involved the local agricultural extension officers of BPTP who will provide technical support to the farmer-participants in the sites.

Workshop findings

Socio-demographic characteristics. Sukamaju village is located in the southern part of Sumatra Island, about 45 km from Bandar Lampung, the district's capital. Most of the people emigrated from Java, so the social culture of the community is similar to that of the Javanese. Farmers in Sukamaju are organized into a community-based organization (CBO); however, it is loosely-structured and is not specifically focused on banana.

Srimulyo village, on the other hand, is located in East Java. The village is divided into four sub-villages: Kerajan (571.4 ha), Balerejo (451.6 ha), Sukorejo (372.2 ha) and Purwosari (651.4 ha), and has a population of about 12 000 people. The community has several farmer groups, with one group (Bumi Mulyo) specific to banana. Bumi Mulyo was organized on 1 May 2006 as an offshoot of an integrated pest management (IPM) farmers-field school project being implemented in the village. The group currently has about 30 members.

Banana production. Sukamaju village was once known as the main banana producing area in South Lampung that supplies the local market as well as nearby Jakarta. Its main variety was Ambon Kuning (AAA, Gros Michele), although other varieties such as Tanduk (AAB, Horn Plantain), Nangka (AAB, cooking banana), Jantan (AAB, cooking banana) and Muli (AA) were planted by small-scale farmers. As Ambon Kuning was susceptible to Fusarium wilt, most of the farmers replaced banana with cacao when the disease hit the community. Currently, farmers in Sukamaju still produce banana, but only those that are tolerant to the disease and only for local consumption.

In Srimulyo, banana is the third most important agricultural crop after cacao and coconut. Varieties planted by farmers vary, but the most popular are Ambon Warangan (AAA, Cavendish subgroup), Kepok Kuning (ABB/BBB), Raja Talun (AAB, Raja Bulu) and Candi (AAB, French plantain). From the time Fusarium wilt infection was first observed in 1997, banana farmers' incomes have significantly declined as most of the varieties planted by the farmers are susceptible to the disease, particularly Ambon Warangan. Today, only 25% of the original number of banana farms in the community still exists.



Dr. Agustin Molina (top) and Mr. Bob Williams (bottom) demonstrating to workshop participants how to identify *Foc*-infected plants in the field.



Ir. Syahyuti, sociologist with the Social Analysis Department of ICASERD, conducting participatory baseline survey of the banana cultivation practices of farmers in Srimulyo village.

Banana cultivation system. In Sukamaju, banana farmers commonly intercrop banana with other high-value crops such as cacao, and they also plant several varieties of banana within the same farm. Farmers use suckers as planting materials, which they get from their own field or which they buy from neighbors (of known good quality). Most farmers do not fertilize their banana plants, although most apply manure once before planting. Bagging, as well as debudding, is not practiced.

In Srimulyo, most banana farmers similarly cultivate banana through conventional methods as Sukamaju farmers. However, their banana production system is somewhat more

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developed probably as a result of the IPM farmer-field school programme developed and implemented by BPTP in the community starting in 2006, which involved the management of Fusarium wilt using bio-control agents. The most common local varieties planted in the community are Ambon Warangan, Kepok and Raja Talun. Farmers use suckers (with a height of 100 cm) as planting materials, which they obtain from their own or from their neighbors' fields. They prune the suckers and maintain a density of three plants per mat. A few farmers use bits as planting material, which they initially grow in polybags. Srimulyo banana farmers practice mixed cropping system (with cacao and coconuts) and observe a planting distance of 3m x 4m, with some farmers growing their banana plants on raised beds. No inorganic fertilizer is applied to the plants, while irrigation is primarily rain-fed. During the dry season, farmers irrigate the plants using water drawn from a nearby river. To prevent the onset of Moko, farmers remove the male bud as soon as the last finger on the stalk develops. Fruits are harvested based primarily on their physical appearance or size and not on their age. In terms of Fusarium wilt disease management, most farmers cut down the infected plants and simply leave them on the ground; however, some inject the infected plants with kerosene to kill it. But generally, farmers do not have a systematic technique to control or manage Fusarium wilt.



Workshop participants of Sukamaju village, Lampung (top) and Srimulyo village, Malang.

Preparing for the field trials

Under the project, a package of best-bet options or strategies for managing Fusarium wilt and improving the productivity of banana would be employed and evaluated in the demoplots. In Indonesia, the demoplots to be established in Sukamaju and Srimulyo villages will have the following components:

1. Use of disease-free (tissue culture) planting materials;
2. Introduction of Fusarium wilt-tolerant/resistant varieties such as FHIA-17 (AAAA), FHIA-21 (AAAB) and Ketan-01 (AAB). To evaluate their performance, one susceptible variety (Ambon Warangan) would be used as control variety in Srimulyo. In Sukamaju, the resistant hybrid FHIA-25 (AAAA) and local variety Ketan-01 will be used. The variant cultivar GCTCV-119 (AAA, Cavendish subgroup), originally intended to be used in the demoplots, will be replaced by Ambon Kuning because local farmers do not want to plant Cavendish-type bananas;
3. Eradication of *Foc*-infected banana mats through rice-hull burning;
4. Introduction of good cultivation practices such as the application of balanced fertilizer, observing optimum planting distance and population per mat, field sanitation and the use of cover crop; and
5. In Srimulyo, the use of bio-control agents as adopted from the IPM farmer-field school using *Pseudomonas fluorescence*. The demoplots will be divided into two trials: 1) best-bet technology including bio-control; and 2) best-bet technology without the use of bio-control agents.

In each village, one farmer's field will be utilized as control. The farmer-owner would be encouraged to continue the conventional method of banana production as traditionally practiced for the duration of the project. The control farm's performance would be regularly monitored and, later on, compared against the performance of the demoplots. - with reports from Agus Sutanto, Plant Taxonomist and Researcher, Indonesia Tropical Fruits Research Centre.

BARI has new Director General



Mr. M. Harun-ur-Rashid, Director General, BARI

The Bangladesh Agricultural Research Institute (BARI) has a new Director General. Mr. M. Harun-ur-Rashid assumed his new post as the head of Bangladesh's top agricultural research organization on 12 March 2007. Prior to becoming BARI's new DG, Mr. Rashid previously served as the Institute's Director for Training and Communication as well as the Director of the Wheat Research Centre from February 2002 to March 2007. He is an Agricultural Engineer, obtaining his Bachelor of Science degree from India and his Master's degree from the United States. His work in the Institute has mostly been associated with research and development of small-scale agricultural implements and machinery, biotechnology and genetic

engineering, integrated pest management, natural resource management, human resource development, technology transfer, development of partnerships with government, non-government and other international organizations, research planning and monitoring and evaluation. Specifically, he was directly responsible for the development of BARI's Soil Conservation and Water Management technology, which has helped numerous Bangladeshi farmers increase their agricultural productivity.

Mr. Rashid has more than a hundred publications credited to his name, including 52 scientific articles published in local and international refereed journals. He has also represented BARI in a number of international seminars, conference and workshops in the US, Japan, China, Indonesia, India, Pakistan and Nepal. As BARI's new DG, Mr. Rashid vows to make BARI a centre of excellence for agricultural research.

IPB banana nematode paper wins Best Poster at PMCP 2007

At the recently concluded 38th Anniversary and Annual Scientific Conference of the Pest Management Council of the Philippines, Inc. (PMCP) held on 20-23 March 2007, the paper entitled "Survey and Damage Assessment of Different Banana Cultivars Infected with Plant Parasitic Nematodes in Davao del Norte, Davao del Sur and Cebu Provinces", a collaboration between the Institute of Plant Breeding – University of the Philippines Los Baños (IPB-UPLB) and the Katholieke Universiteit Leuven, Belgium (KUL) won the Best Poster Award given by the Philippine Phytopathological Society, Inc. (PPS). The conference and awarding ceremony was held at the Bohol Tropics Resort in Tagbilaran City, Bohol, Philippines.

The paper featured the results of the project on Enhancing the Capacity for Nematode Management in Small-Scale Banana Cropping System funded by Bioversity International, the Flemish Inter-University Council and KUL. It was jointly authored by Drs. Rustico Zorilla, Teodora Dizon, Felipe dela Cruz, Jr. and Ms. Marita Pinili of the Crop Science Cluster of IPB-UPLB, Dr. Dirk de Waele of KUL, and Dr. Inge Van den Bergh of Bioversity International.

Survey and Damage Assessment of Banana Cultivars Infected with Plant Parasitic Nematodes in Davao del Norte and Cebu Provinces
 RA Zorilla¹, TO Dizon², FS Dela Cruz, Jr.³, MS Pinili⁴, AG Castillo⁵, TO Reyes⁶, SM Calderon⁷, LC Del Mundo⁸, D De Waele⁹ and I Van den Bergh¹⁰

¹Crop Protection Cluster, UP Los Baños, College, Laguna
²Quality of Plant Breeding – Crop Science Cluster, UP Los Baños, College, Laguna
³Katholieke Universiteit Leuven, Belgium
⁴International Network for the Improvement of Banana and Plantain, WRI, College, Laguna

Introduction
 Since early 70's, surveys on nematodes associated with Giant Cavendish and local banana cultivars were conducted in different parts of Visayas, Mindanao (1973-74) and Luzon provinces (1975) by Dizon, Geronimo and Zorilla (1982). Surveys found that banana cultivars were infected with different nematode genera namely: *Meloidogyne*, *Heterodera*, *Hoplodiplosis*, *Rhizoglyphis*, *Tylenchorynchus*, *Hoplostemon*, *Pteronichus* and *Xiphinema*. Recently, Zorilla et al. (2005) also found the same genera of nematodes affecting banana cultivars in small-scale cropping system in areas of Oriental Mindoro, Quezon and Quezon province with Mindogon¹, Ruedigera² and Iloilo³ provinces as the prevalent and destructive nematodes based on nematode recovery and root damage assessment.

Objective
 To determine the damage potential of parasitic nematodes associated with different banana cultivars in Davao del Sur, Davao del Norte and Cebu province.

Methodology
 Survey and Collection

RESULTS
 Average percent shoot death, root necrosis and galling indices of banana cultivars in Davao del Sur

Cultivar	Survey	Shoot Death (%)	Root Necrosis (%)	Galling Index	Sample Size (n)
Lakeland	AAA	24.0	2.0	0.0	10
Lakeland	AAA	22.0	2.0	0.0	10
Lakeland	AAA	13.0	0.0	0.0	9
Morita	AAA	28.0	0.0	0.0	2
Morita	AAA	20.0	0.0	0.0	2
Prieta	AAA	18.0	0.0	0.0	2
Trinidad	AAA	7.0	0.0	0.0	2
Small Cavendish	AAA	0.0	0.0	0.0	2
Manila Pink	AAA	0.0	0.0	0.0	2
Indica	AAA	0.0	0.0	0.0	2
Indica	AAA	0.0	0.0	0.0	2
Musa	AAA	0.0	0.0	0.0	2

RESULTS
 Average percent shoot death, root necrosis and galling indices of banana cultivars in Davao del Sur

Cultivar	Survey	Shoot Death (%)	Root Necrosis (%)	Galling Index	Sample Size (n)
Lakeland	AAA	11.0	0.0	0.0	10
Lakeland	AAA	10.0	0.0	0.0	10
Lakeland	AAA	4.0	0.0	0.0	10
Morita	AAA	22.0	0.0	0.0	2
Lakeland	AAA	19.0	0.0	0.0	2
Prieta	AAA	10.0	0.0	0.0	2
Trinidad	AAA	10.0	0.0	0.0	2
Small Cavendish	AAA	0.0	0.0	0.0	2
Manila Pink	AAA	0.0	0.0	0.0	2
Indica	AAA	0.0	0.0	0.0	2
Musa	AAA	0.0	0.0	0.0	2

Literature Cited
 Dizon, RG. 1982. Studies on nematodes affecting bananas in the Philippines. Phil. Agric. and Research Foundation, Inc. 178 p.
 Zorilla, RA. 2005. Enhancing capacity for nematode management in small-scale banana cropping systems. Ann. Report.
 Acknowledgement
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PCARRD reviews banana R&D activities, draws up workplan with partners

The Philippine Council for Agriculture, Forestry, and Natural Resources Research and Development (PCARRD) recently held its annual multi-stakeholder Banana R&D Review and Planning Meeting on 26-27 July 2007 at Arisabel Resort, Los Baños, Laguna, Philippines. The event is a regular activity coordinated by PCARRD in collaboration with Bioversity



Dr. Patricio Faylon (upper right), PCARRD Executive Director, addressing participants of PCARRD's 2007 banana R&D review and planning workshop

International and the Department of Agriculture - Bureau of Agricultural Research (DA-BAR). The meeting aimed to review and evaluate the accomplishments and plans of the banana R&D collaborative projects being funded by the Department of Science and Technology (DOST), PCARRD, Bioversity and DA-BAR. It also provides a venue for researchers and extension workers to be updated on the current banana R&D activities and create a network of banana experts, as well as for researchers to gather

feedback to further improve the implementation of their respective projects.

The event was opened by Dr. Patricio S. Faylon, Executive Director of PCARRD, Dr. Teodoro Solsoloy, Assistant Director of DA-BAR, and Dr. Agustin Molina, Jr., Asia-Pacific Regional Coordinator of Bioversity International's *Musa* Programme. In

their messages, they summarized their respective organizations' past and current banana R&D activities, emphasizing the importance of inter-agency and private sector cooperation and collaboration in addressing current issues in banana and plantain. They especially focused on emerging concerns such as pest and disease management (i.e., Fusarium wilt, Sigatoka, Banana Bunchy Top Virus disease, Moko and Bugtok), improving crop productivity, value-adding and developing markets, and increasing incomes for small-scale farmers in particular and the banana industry in general.

Represented during the two-day meeting were partners of Bioversity International and members of the national banana R&D network, which include the DA-BAR, the Crop Science Cluster of the College of Agriculture - University of the Philippines Los Baños (UPLB), the Institute of Plant Breeding - UPLB, DOST, and the Bureau of Plant Industry. Also participating were representatives of collaborating state colleges and universities including Cavite State University, Isabela State University, Nueva Viscaya State University, Ilocos Sur Polytechnic State College, Mariano Marcos State University, and Pampanga Agricultural College. ■

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The Commodities for Livelihoods is a programme of Bioversity International

Announcement

The 1st Joint Meeting on Crop Protection of the International Society for Horticultural Sciences (ISHS) and the Global Programme for *Musa* Improvement (ProMusa) of Bioversity International, 10 - 14 September 2007, White River, South Africa (fee-based and by prior registration).

This is the first of what will be an annual symposia of the ProMusa working groups for Crop Protection, Crop Production and Crop Improvement. The event will comprise a three-day symposium, a field visit to banana farms and a one-day workshop. The social programme will include a welcome reception and a symposium dinner.

The symposium is fee-based; discounts will be given to students who wish to attend. For more information about the symposium and to download the electronic registration form, please visit http://www.promusa.org/symposium/2007_symposium_welcome.php or email the ProMusa Coordinator, Dr Inge Van den Bergh, at i.vandenbergh@cgiar.org.