

# Pesticide Reduction Plan for Banana

## Banana, Food Security and the Environment

Over the last 40 years global banana production has quadrupled to 100 million tons. Approximately 20% is exported, with a share of more than 60% to the European Union and the United States of America where bananas are widely appreciated as energy fruits and due to their rich vitamin B6 content. These so-called dessert bananas are either produced in large industrial plantations or primarily by independent - or cooperatives of - small holders and are largely locally consumed as an essential component of the daily intake of millions of people. This underscores the significance of bananas as a major world food crop (fourth after wheat, rice and corn) that is widely consumed as a staple, particularly by small holders in Africa, Latin America and South-East Asia.

The commercial banana production, for export as well as local consumption, is an example of extreme monoculture of the so-called Cavendish banana that requires an excessive amount of agrochemicals to control the plant pathogenic fungus *Mycosphaerella fijiensis*, which is the cause of the feared Black Sigatoka disease

(<http://en.wikipedia.org/wiki/banana>). The annual input of these agrochemicals (fungicides) approaches 400 million US\$ on a relatively small acreage that is devoted to the production of export bananas. Even in very well organized and managed plantations, weekly fungicide applications are necessary to control the disease with all the risks for laborers in the plantations and the environment. Small holders are therefore under double threat; their crops are as susceptible as those on industrial plantations, but their economic position disables access to effective control measures. This was recently confirmed under African conditions where Black Sigatoka is virtually out of control because farmers cannot apply fungicides. Moreover, the pathogen is aggressively colonizing new banana growing areas, exemplified by Brazil, the second largest banana producer in the world, where it initially appeared in the Amazon areas in 1998 and since then progressively entered into other areas, despite phytosanitary barriers and sanitation programs, such as the South East Sao Paulo area in 2004 from where it expands into the main banana production areas. On top of that, the burrowing nematode *Radopholus similis*, which is a microscopic worm infecting banana roots, is a major threat to banana plantations world-wide and its control requires the input of costly and environment threatening agrochemicals called nematicides.

## The goal for the coming decade

Seventy years of classical plant breeding efforts have not resulted in banana cultivars even close to the agronomical characteristics and quality of the market dominating Cavendish bananas. Close to 70% of these export banana is produced in just four countries (Ecuador, Costa Rica, Philippines and Colombia), which represents just a relatively small percentage of the global banana production that is distributed over more than 100 countries. Hence, a global strategy involving all stakeholders, from industrial cooperatives to local small holders, of the banana production chain is urgently required to secure food production and reduce pesticide inputs. As the global production is largely in the hands of numerous small growers, technology ought to be driven by local requirements, should be collaboratively developed and applied and must be freely available.

Wageningen University and Research Centre (Wageningen UR, [www.wur.nl/UK/](http://www.wur.nl/UK/)) and the globally renowned research institutes EMBRAPA (Brazilian Agricultural Research Corporation, [www.embrapa.br/English/index\\_html/mostra\\_documento](http://www.embrapa.br/English/index_html/mostra_documento)), Bioversity International, [www.bioversityinternational.org](http://www.bioversityinternational.org)), CIRAD (Centre de cooperation internationale en recherche agronomique pour le développement, [www.cirad.fr/en/index.php](http://www.cirad.fr/en/index.php)) and the Catholic University of Leuven, [www.biw.kuleuven.be/DTP/TRO/\\_data/home.htm](http://www.biw.kuleuven.be/DTP/TRO/_data/home.htm)) embarked on the threatening situation for numerous small holders and developed an integrated multidisciplinary research plan focusing on food security and pesticide reduction: The Pesticide Reduction Plan for Banana (PRPB). The ambition of the PRPB is to achieve a 50% pesticide reduction in 10 years through an integrated and multidisciplinary approach. PRPB will encompass fundamental and applied research programs with a focus on food security and a spin-off to the export banana production that is largely controlled by cooperatives of

contracted small holders (Figure 1). The emphasis of the PRPB is on the control of the Black Sigatoka disease and Radopholus nematodes and will lead to innovative disease management strategies that will result in a socially and environmentally sustainable banana production. Collaborative programs with for example partners in Sub-Saharan Africa are essential for the development of the PRPB. In this region banana is an essential component of the daily menu for millions of people (in Uganda, the banana based Matoke is a staple food with an annual consumption of >300 kg per capita) but production is threatened by Black Sigatoka en nematode infestations.

#### **The slogan for the PRPB is 'Focus on the Farm'**

All research activities will directly or eventually contribute to practical solutions that will substantially improve banana production and quality. The PRPB is therefore organizationally flexible and dynamic in order to promote actions that will result in technology development and transfer on the short, middle and long term. Short-term actions will maximize kick-start impact by exploiting and applying existing but hardly accessible knowledge for example on plant nutrition and agronomical measures, but also comprises the identification of production systems and research sites for on-farm research in major banana producing areas, define with partners an agreed research agenda and a methodology for pesticide monitoring, and establish a multi-stakeholder platform. Other aspects require middle/long-term strategies before application can be considered, such as (i) continue the DNA sequencing of the banana genome, (ii) exploitation of the completed DNA sequencing programs of the Black Sigatoka pathogen *Mycosphaerella fijiensis* ([www.igi.doe.gov/sequencing/why/CSP2006/mycosphaerella.html](http://www.igi.doe.gov/sequencing/why/CSP2006/mycosphaerella.html)) and (iii) developing superior, disease resistant bananas, either by conventional technologies or cis-genic strategies (appendices 1 and 2). These important innovations will revolutionize the understanding of the banana-pest interactions that will be applied in durably sustainable banana production programs.

#### **PRPB is an innovative, integrated plan for a durable solution**

It is the responsibility of the PRPB to ensure farmers' access to the generated know-how and products in order to apply it under their conditions. The flexibility of the program will enable the PRPB consortium to continuously embrace bottom-up research questions in order to adapt the research agenda to maximize impact and to be prepared for potential new threats such as new races of the soil-borne fungus *Fusarium oxysporum* that causes the devastating Panama disease, which wiped out commercial banana production in Central America in the 1960's. Hence, social and community aspects of communication and translation of results are crucial to the PRPB, which is therefore a multidisciplinary initiative that is adopted by a consortium of stakeholders spanning the entire banana production chain (Figure 2).

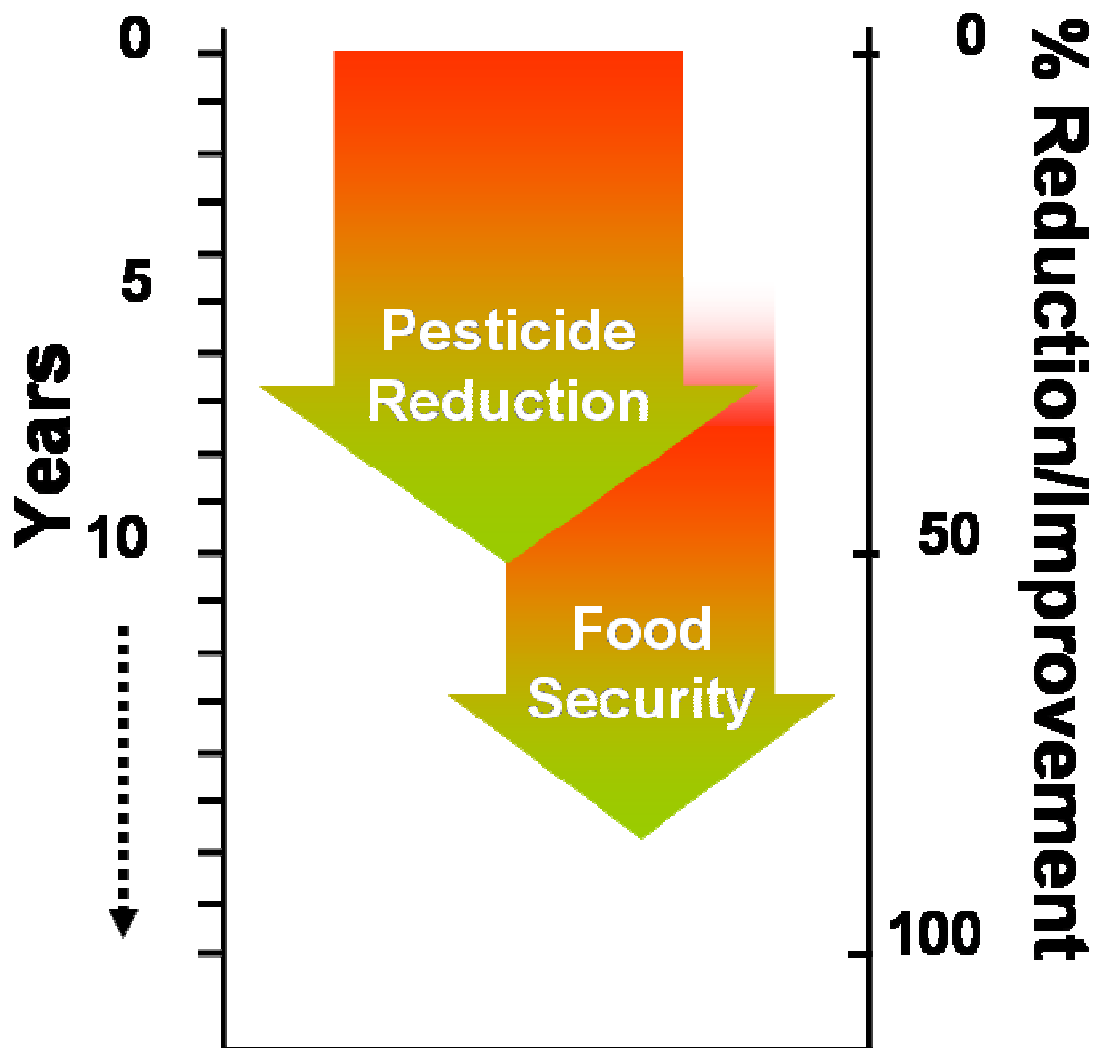
An important add-on satellite program of the PRPB is to stimulate additional economic activities that add value to banana production. We will focus on establishing small scale alternative paper production units that exploit banana stem wastes. These stems are traditionally left to rot in the plantations after every 9-month harvest. In PRPB they will be the input for an environmentally sound and innovative paper production program that will be established with technology developed by the Australian company Papyrus ([www.papyrusaustralia.com.au](http://www.papyrusaustralia.com.au)).

#### **State-of-the-art**

The Common Fund for Commodities (<http://www.common-fund.org/>) requested Wageningen UR and its partners to perform a PRPB feasibility study. All ins- and outs of the PRPB were evaluated and discussed during a stakeholder meeting in November 2007 that comprised a representation of the global banana chain. Wageningen UR and EMBRAPA, together with the Federal University of Lavras (one of the top universities in agricultural research in Brazil - <http://www.ufla.br/>), CAPES (<http://www.capes.gov.br/> - a foundation from the Minister of Education in Brazil), as well as the Mexican Council for Science and Technology (CONACyT), have recently embarked on a strategic alliance addressing banana research that will enable the training of a range of PhD students and post-docs from developing countries and the participation of researchers and students in short term programs with a focus on plant sciences. Wageningen UR and its partners successfully merged into one targeted

international research consortium that adopts a common stakeholder-defined research agenda, which contributes significantly to the coherence of the PRPB aiming at implementing its results and creating (local) opportunities for talented students. The PRPB consortium comprises a unique combination of research teams, producers and industry with a long-standing globally recognized expertise in their respective fields. Bringing such diverse disciplines as agronomy, plant breeding, plant pathology, soil and social science together in a fundamental-applied science umbrella program is unique and exactly what is required to ensure progress in a complex environment.

*Figure 1: Aim of PRPB during the next decade*



**Figure 2. Lay-out of the PRPB, an integrated multidisciplinary program to improve food security and to reduce pesticide input in banana production by 50% in 10 years.**

