Worldwide Coconut Production – Importance & Impact of the Lethal Yellowing Disease

Production Mondiale du Cocotier – Importance et Impact du Jaunissement Mortel du Cocotier

Justification and Objectives of the International Workshop
Justification et Objectifs d'un Atelier International

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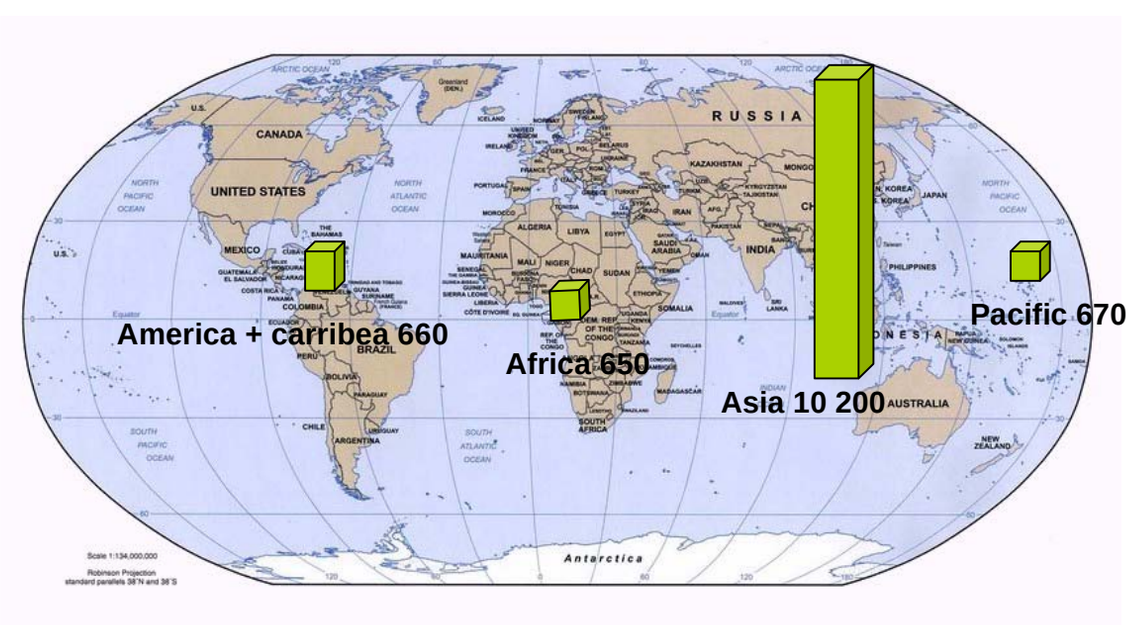
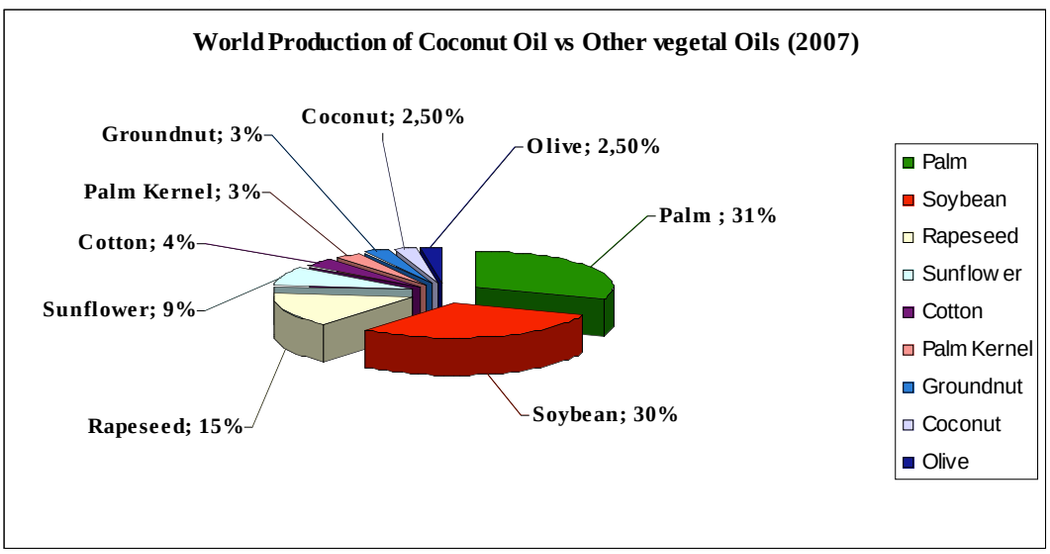
1. Worldwide Coconut Production

The world Coconut production is growing at a low pace compared to other oilseeds. Unlike short-term crops such as soybean, sunflower or rapeseed, whose planting can be planned according to the market demand, coconut as a perennial crop cannot be programmed for the short term. Coconut is predominantly a smallholder's crop grown by millions of resource-limited farmers, mostly in developing countries in the tropics. Since 10 years (1998-2007) the area planted to coconut in the world is slightly fluctuating around 12 million hectares. About 87% of coconut lands are in the member countries of the Asian and Pacific Coconut Community (APCC). World coconut production in 2007 was 10.3 million MT in coprah terms. The largest share of coconut production in 2007 was recorded in Asia with 72% (Indonesia and the Philippines represent 29.8% and 18.0% respectively) other regions (Africa, Latin & Central America, Carribea) represent 28% of the global production.



Coconut uses are much diversified including the selling of fresh nuts for water on the local market and in some cases for export, the processing of coconut oil and the development of a cottage industry with confectionaries made from dried coconut. Coconut oil competes with other sources of fats and oils in the

world market. In 1960 with a production of about 2 million MT, coconut oil was representing 12% of the global vegetal oils production (16 million MT). According to APCC, FAO & Oil World (see figure below) in 2007 the production of coconut oil is of about 3 million MT and represents only 2.5% of the global vegetal oils production (125 million MT).



The Price of coconut oil in the world market showed an upward trend since January 2007 as the price went up by 5.3% per month. In December 2007 price was of US$ 1,150 per MT (CIF Rotterdam). The fundamental cause of the improved price is the relatively low world production of coconut with diversified used including edible purposes, biofuels, oleochemical products and pharmaceutical products.

2. The Lethal Yellowing Disease (LYD)

The lethal Yellowing Disease (LYD) is one the main pandemic diseases affecting coconut worldwide. Lethal yellowing is a phytoplasma disease of coconut and other palms. It is an epidemic in the Caribbean from Florida to Honduras. The lethal Yellowing syndromes can also be found on coconut palms in West and East Africa. In Ghana, about one million coconut palms have been killed during the last 30 years. In Togo, about 50% of the coconut groves were destroyed during the same period. Nigeria, Kenya, Tanzania and Mozambique were also affected but no precise evaluation is available. Phytoplasmas have recently been associated with coconut diseases in Southeast Asia.

"Yellow diseases" so named because of the symptoms they cause, were all originally thought to be caused by viruses. In 1967, Japanese workers showed that mycoplasma-like organisms (MLOs) could be found in the yellow-affected plants and that symptoms could be alleviated by antibiotic therapy. Mycoplasmas are wall-less procaryotes, which can be pathogens of man, animal and plants. The term, "phytoplasma" was introduced to describe these MLOs. DNA molecular analysis has shown that the phytoplasmas associated with coconut LYD from Africa and the Caribbean are similar but not identical.

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Research programmes are being conducted in Honduras, Guatemala, Florida, Jamaica, Mozambique, Tanzania, and Ghana with the following objectives:

- Select resistant germplasm and replant tolerant or resistant varieties as a component of an integrated control.
- Understand the transmission and propagation of the LYD.
- Have a better knowledge of the diversity and variability of the different Phytoplasmas associated with these lethal yellowing syndromes.
- Discover the reservoirs of the Phytoplasmas, and understand the bases of the epidemiology.

2.1. Select resistant "Germplasm"

Malayan Dwarfs were the first cultivars identified as LYD resistant during the 1950s in Jamaica. They have been planted on a large scale in that country and in Florida. However, these dwarfs were found to be quite sensitive to other environmental stresses such as drought, insect attacks, or hurricanes. They were progressively replaced by a new tolerant hybrid, more resistant to the other stresses.
In Tanzania, imported cultivars are being screened. To date, all imported cultivars, including those reported to be resistant in Jamaica, are highly susceptible to the disease. Since the 1980s varietal screening tests are being conducted in Ghana. The most tolerant cultivars identified are the Sri Lanka Green Dwarf (SGD) and the Vanuatu Tall (VTT). Recently new dwarf varieties were introduced from Côte d'Ivoire for resistance screening.

2.2. Transmission and propagation of the LYD

Phytoplasmas are known to be associated with coconut lethal yellowing. It is also known that all Phytoplasma-related diseases are transmitted by leafhoppers, planthoppers or by Psyllidae.
Transmission by insect vectors collected from diseased palms or in diseased areas has been reported only in Florida but has not been successful elsewhere. In Florida, *Myndus crudus* was implicated (Howard et al., 1983). Transmission tests using caged palms in Ghana, Mexico and Tanzania have also been unsuccessful. Until now, it has never been possible to confirm the vector role of *Myndus*.

From 1990, disease transmission studies were undertaken in Ghana (World Bank funding, European Union). The French Cooperation has been funding, from 2005, a new research program on the local coconut lethal yellowing, called Cape Saint Paul Wilt (CSPW). The search for the vector is done by introduction, into cages housing coconuts, of insects of different species, genera and families, gathered in CSPW affected coconut plantations, until disease symptoms appear in the cage. Controls of the presence of the CSPW phytoplasmas in these coconuts are done by PCR every two months.

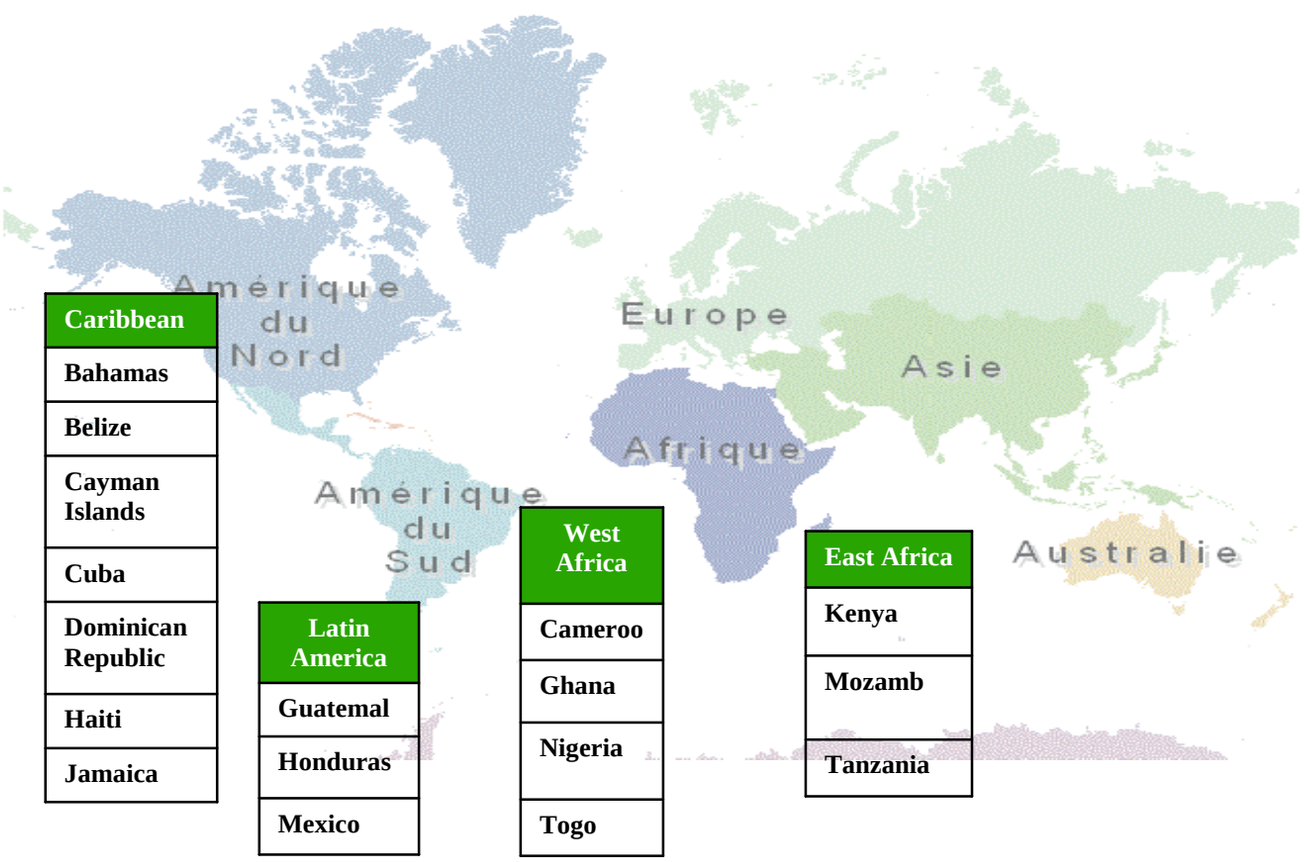
PCR are also done on insects from the affected fields in order to know if they host the CSPW Phytoplasma. A molecular Biology Laboratory was installed at Takoradi (Oil Palm Research Institute – OPRI) in order to detect the phytoplasmas associated to CSPW by Polymerase Chain Reaction (PCR). Phytoplasmas are wall-less phloem-restricted bacteria that cannot be *in vitro* cultured. Detection can only be made by electron microscope and molecular biology. Processing large numbers of samples is not possible under the electron microscope. It is why a molecular biology laboratory was installed and equipped at Takoradi to implement techniques of Polymerase Chain Reaction (PCR). The PCR technique consists in amplifying specific zones of the genome (from insects or from coconut trees) using defined DNA primers and visualizing the resulting

product by agar gel electrophoresis. In fact, the absence of proven case of the disease in the “transmission” cages has led to test for the presence of the Phytoplasma responsible for coconut LYD directly on sucking insects that are potential vectors of the disease.

Seed transmission of LYD has never been demonstrated. The statistical probability of seed transmission may be infinitesimally small, yet not zero. Artificial transmission has been attempted, using carborundum inoculation, pressure inoculation or parasitic plants such as *Cassytha filiformis*, but without success.

2.3. Diversity and variability of phytoplasmas associated with coconut yellowings

Under the term of phytoplasma, there are plenty of mollicutes belonging at, at least, 20 different groups, each of these groups being divided in several sub-groups. So far, all phytoplasmas found in coconuts are in a same group (except one associated with Blast disease of coconut and oil palm). However there are differences in their ribosomal RNA gene sequences. And there are differences in the syndromes associated with these phytoplasmas. All the phytoplasmas do not induce quick death of the coconut. For instance in Mexico there are phytoplasmas in coconuts with some yellow leaves (Lethal Decline Yucatan -LDY) but with a syndrome different of the LY syndrome. The phytoplasmas of LDY and those of LY are close but different. In Africa there are different phytoplasmas, all of them different from the phytoplasmas from the Caribbean. Then we can imagine there could be different vectors, different epidemiology for these different syndromes.



2.4. Epidemiology

The spread of CSPW in Ghana is different from the spread of of the lethal yellowing syndrome of Kenya. In Tanzania there are differences in the spread of the LDT in the South and in the North. Epidemiology of LY in the East of Cuba is different from the epidemiology in the South Centre. Epidemiology of these syndromes is still quite mysterious. In Jamaica it seems some weeds can host the LY phytoplasmas. Weeds and palms are also studied in Ghana. In Ghana, inquiries started in 2007 by visiting more than 600 small farmers' plantations. On the other hand, trials using aerial surveys and remote sensing are tested for studying the propagation studies.

3. Justification for an International Workshop

Coconut is a cultivated plant of great social and economic interest to populations in the affected areas. This resource is one of the best adapted to soils and climate of the coastal zones and is often the only crop that can be grown there. In the absence of curative or preventive treatments, the eradication of diseased trees remains the only means of fighting this phenomenon and of avoiding a fatal outcome for the remaining trees. Since 1983, when, *Myndus crudus* was identified in Florida by Howard et al. , as a vector of the LY all experimentations and trials (implemented on the same experimental protocol in Jamaica, Mexico, Ghana, Tanzania, …) failed to understand the transmission of this type of diseases. Difficulties shared by all research teams all over the world to identify transmission mechanisms, to fight against the disease and even to select resistant Germplasm justify the proposition of the French Cooperation to organize an international workshop where research teams would discuss their results, propose new ways of research and define together a new common and complementary research programme.

3.1. Objectives of the workshop

The scientific objectives of the workshop were designed in February 2008 as follows:

- Situation and impact of the LYD in the world – The LYD in Africa;
- Worldwide state of the research on LYD. Presentation of the main results by the various research teams (USA, Mexico, Jamaica, Tanzania, Ghana…). This will give the opportunity to the Ghanaian and French researchers of the Ghanaian project to extensively present and discuss their work.
- Discussions on complementarities between research teams and research programmes around the world and in Africa, giving an opportunity to a broad community of researchers to share their knowledge in the design of prospects for the future.
- Identification of research themes to be strengthened – New research ways to be prospected…

4. Conclusion

The development of the coconut commodity chain and the incomes of the producers are closely dependent on measurements which will be taken to maintain levels of attractive prices, to contain the extension of the lethal yellowing disease, and on being able to set up the conditions of investment necessary to the development of the sector of the production (improved material, credit…).

Concerning the scientific research about this disease, the complexity and the importance of the means to implement militate for an internationalization and a coordination of these means. Scientific research on Mortal Yellowing is currently undertaken to Mexico, the Caribbean and in Tanzania. This national research is based however at the same time on the potential of network COGENT (Coconut Genetic Ressources Network) and on an exemplary co-operation with the CIRAD which places at the disposal of research, its laboratories of Montpellier where researchers, Phd can be accommodated and where are carried out the analyses in molecular biology.

This workshop will allow to the researchers from different countries in the world to present their results, to confront them with those obtained by the scientific team of Ghana. Of this debate one hope for a setting in network of all this scientific potential. An internationalization with the establishment of a real scientific network is indeed necessary to progress on the comprehension of the disease and its combat. That will require to specify the axes of interventions, methods and sites of intervention. It will imply a pooling of knowledge and expertises. Unit should be made what separately no country can do it. In this context, FARA (***Forum for Agricultural Research in Africa***) of which is one of the mandates is to support the scientific partnerships in Africa but also between Africa and the world is already to propose for a role of facilitation. The definition then implementation of a real international program undertaken in network will make it possible to take a more ambitious action to the current research programs and to obtain more various financial contributions, more important.

References

- Bene Serge, Courbet Philippe : “The Coconut Commodity Chain in Ghana and Nigeria”. International workshop on Coconut Lethal Yellowing Disease, Accra 3-6 June 2008.
- Dollet M., Fabre S., Pilet F., Quaicoe R., Mugini J.A., Rassaby L. (2006) - Variability and diagnosis of coconut lethal yellowing Syndromes in Africa. 16th International Congress International Organization for Mycoplasmology (IOM) - Cambridge, United Kingdom. 9-14 July 2006.
- Howard, F.W., Norris, R.C., and Thomas, D.L. 1983. Evidence of transmission of palm lethal yellowing agent by a planthopper, *Myndus crudus* (Homoptera, Cixiidae). *Tropical Agriculture* 60:168-171.
- Logan Tracy: The Coconut Commodity Chain in Latina America and the Caribbean”. International workshop on Coconut Lethal Yellowing Disease, Accra 3-6 June 2008.
- Philippe, R., J. Nkansah Poku, et al. (2007). "Search for the vector of Cape Saint Paul Wilt (coconut lethal yellowing) in Ghana." Bulletin of Insectology **60**(2): 179-180.
- Romulo N. Arancon, Jr.: “Price outlook of coconut (lauric oil) 2008/09”. Asian and Pacific Coconut Community (APCC) at the 19th Annual Palm & Lauric Oils Conference & Exhibition: Price Outlook 2008/09 (POC2008/09), 25 – 27 February 2008, Kuala Lumpur Convention Center, Malaysia.