COCOTECH 2010, Samui Island, Thaïland.

44th APCC Cocotech Meeting and Coconut Festival 2010/07-05-09 Samui Island, Thailand.

R & D updates on the Lethal Yellowing type diseases of coconut.

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Coconut palms (*Cocos nucifera* L.) can be affected by several Lethal Yellowing Types Syndroms (LYTS) worldwide. In the Caribbean, Lethal Yellowing (LY) was rife in the Cayman Islands in the 1830s. Haiti and Cuba were also affected in the late 19th century. Since then, LY has spread in Central America (from Mexico to Honduras). Recently LY reached Nevis Island on the east side of the Caribbean. A similar disease was observed on coconut palms in East Africa, at the beginning of the 20th century, then in West Africa (Togo, Ghana, Nigeria and Cameroon) where local names were given to them (Maladie de Kaïncopé, Cape St Paul Wilt -CSPW- etc.). In the 1970s it was possible to diagnose Mycoplasma Like Organisms (MLO) by electron microscopy. The trivial term “Phytoplasmas” was accepted in 1993. Today diagnosis and characterization are done by Polymerase Chain Reaction (PCR): by amplification of the gene of the ribosomal RNA operon of these microorganisms. But, RFLP and sometimes sequencing are necessary to complete the diagnosis. However, it needs to be known that, in the Caribbean zone, two other coconut diseases, Hartrot caused by a trypanosomatid and Red Ring, caused by nematodes can be confused with LY. At least other LYTS can originate in abiotic stress like many mineral deficiencies or draught.

There are around 28 "groups" of phytoplasmas involved in hundreds of plant diseases. But only one pair of primers -P1/P7- called “universal phytoplasmas primers”, is commonly used for PCR diagnosis. As these primers belong to a much conserved gene, false positives are frequent. Saprophytic and insect mycoplasmas and even bacteria can be amplified when using these primers. Consequently, alternative primers specific to one "strain" (or subgroup) have to be used, such as LY-F/LY-R for the Caribbean LY, or specific primers for the LYTS of Tanzania. Indeed, there is variability within each strain and the sequence of the primers has to be adapted to that variability. So far all LYTS phytoplasmas, from the Caribbean and Africa were put in a same ribosomal group 16S rDNA IV in which there was 5 subgroups (different LYTS “strains” in a way). But recently it was proposed, using computer-simulated RFLP analyses that LYTS phytoplasmas from Ghana and Nigeria could form a new 16S group (XXII). Last studies made in 2008-2009 on the phytoplasmas associated with the LYTS from Tanzania showed there were at least two main groups containing a total of eight different genotypes. Both groups are different from the group XXII, what means that one or two other new groups associated with LYTS could be proposed very soon. It means there is not only one disease called “coconut LY”, but several coconut diseases caused by different phytoplasmas probably transmitted by different vectors.

The diversity and variability of LYTS is also reflected in the resistance of coconut varieties to these different syndromes. For instance, the Vanuatu Tall variety (VTT) was highly susceptible to LY in Jamaica, whereas the Malayan Yellow Dwarf (MYD) displayed a degree of resistance in the 1960s to 1980s. In Ghana, the VTT is fairly resistant to CSPW and the

MYD is highly susceptible. In addition, whereas "Local Tall" coconut palms (West African Tall) in Ghana are highly susceptible to CSPW, there are several "Local Tall" ecotypes (East African Tall) that display a degree of resistance to LYTS in Tanzania. In Florida and Jamaica, MYD and hybrids MAYPAN considered as resistant to LY in the 70s were severely affected by LY at the end of the 90s. MYD and MAYPAN plantations have been fully destroyed in Jamaica. In Ghana, the Sri-Lanka Green Dwarf has shown high resistance to CSPW and the hybrid SGD × VTT is under observation to determine its performance. A seed garden for SGD × VTT has been planted. A programme to rehabilitate the CSPWD-devastated areas was started in 1999.

So far, Florida is the only place where a vector – *Myndus* (*Haplaxius*) *crudus*, Cixiidae has been identified. These last four years, trials to reproduce this result with the same species in Mexico, failed. In Ghana similar trials were done between 2001 and 2009. Another cixiid – *Myndus* (*Myndodus*) *adiopodoumensis* was suspected to transmit CSPW. But even with 70.000 insects of this species introduced in one cage, transmission of the CSPW was not obtained. More than 140.000 other insects (Cicadellidae, Derbidae, Deltocephalinae, Pentatomidae etc.) also failed to transmit the CSPW. One derbid -*Diostrombus mayumbensis*- was found from time to time to harbour the CSPW phytoplasmas but could not transmit the disease.

In 2008-2009 in Mozambique, mapping of the distribution of the local LYTS, in Zambezia and Nampula provinces, at a minimum scale of 1:100 000 was done on the basis of aerial pictures. Maps at a minimum scale of 1:25 000 with foci with less than 10% of dying or dead coconut palms showing the most recent foci of the disease where produced.

Recently, other phytoplasmas have been implicated with coconut disorders in Malaysia (a kind of LYTS): they belong to different an already known group: 16Sr XIV. In Sri Lanka phytoplasmas of the 16Sr XVI were identified in the “Weligama leaf wilt disease” disorder with symptoms resembling Kerala wilt symptoms in India. The aetiology of this last one remains unclear. Some authors claim it is a 16Sr IV and others published in 2010 it was a group 16Sr XI phytoplasma (Rice yellow dwarf group). At least another 16Sr XI phytoplasma occurs in Indonesia associated with the Kalimantan wilt of coconut.

References : *OCL*, 2009, VOL. 16 N° 2 March-April, p. 74- 136 *(http://www.revue-ocl.fr/)*