MTF/MOZ/098/STF (STDF 230)

ESTABLISHMENT OF COCONUT LETHAL YELLOWING DISEASE (CLYD) PEST FREE AREAS IN THE SOUTH OF THE RIVER ZAMBEZI IN MOZAMBIQUE

Terminal Report

Prepared for the Government of Mozambique

By

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1. EXECUTIVE SUMMARY

Coconut is one of the major crops in Mozambique and has direct influence on food security for 14-30% of rural families living in coastal areas. Approximately 62,000 tons of copra produced annually is exported or used locally for oil production and local consumption and about 50% of total coconut production is consumed locally, thereby contributing significantly to nutrition and income for the rural households.

The coconut industry in Mozambique is currently affected by coconut lethal yellowing disease (CLYD). The disease has been confirmed in the central and northern regions of the country. However, there has been no record of the occurrence of the disease in the south of River Zambezi.

The project “MTF/MOZ/098/STF STDF 230” was funded by the Standards and Trade Development Facility (STDF) to establish lethal yellowing-free areas in the south of Mozambique and to determine the phytosanitary measures that would be needed in declaring the southern region a CLYD free area (CLYD – PFA). The technical and financial management of the project was under the responsibility of FAO-Mozambique while the technical support was provided by the International Plant Protection Convention (IPPC) Secretariat.

This report presents the activities carried out under the project and the results of surveys and diagnostic studies conducted from July 2009 to August 2011 to determine the status of CLYD in the region south of River Zambezi. It was anticipated that this would serve as a pre-requisite for declaring a CLYD- Pest Free Area (CLYD-PFA) in accordance with the provisions of International Standards for Phytosanitary Measures, in particular ISPM No. 4 as per the surveillance work conforming to ISPM 6:1997 (*Guidelines for surveillance*) and determination of pest status in an area as per the provisions of ISPM 8: 1998 (*Determination of pest status of an area*) to be applied in the management of CLYD on coconut palms.

The surveys indicated low levels of presence of CLYD in the south of River Zambezi at three small locations in Xai-Xai, Vilankulo, and Machanga, in Gaza, Inhambane and Sofala provinces respectively. Since a few CLYD infected trees were found during the surveys, the proposal that the area be classified under the PFA type of *"an un-infested part of a country in which a limited infested area is present"* (according to ISPM 4: 1996 (*Requirements for the establishment of pest free areas*) would ignore critical elements on possible latent infections which, due to factors not investigated conclusively under the project, may lead to erroneous conclusion on the status of the disease. Together with the apparent unclear role of some of the insects present on coconut in the area as potential vectors of the causative agent of CLYD and the possibility of existence of different strains of the pathogen that may express differently in different host cultivars, cautious approach to declaration of south of River Zambezi as CLYD-PFA was necessary. With the available information, the NPPO is not in a position to validate the PFA declaration or limited distribution of CLYD in Southern Mozambique. Further studies and additional resources will be needed to conclusively ascertain the status of CLYD in this region.

2. ABBREVIATIONS/ACRONYMS

ALPP	Area of Low Pest Prevalence
CIRAD	La Recherche Agronomique pour le Development
CLYD	Coconut Lethal Yellows Disease
FAO	Food and Agriculture Organization of the United Nations
ISPM	International Standard for Phytosanitary Measures
IPPC	International Plant Protection Convention
NGO	Non Governmental Organization
NPPO	National Plant Protection Organization
PFA	Pest Free Area
PFPP	Pest Free Places of Production
PMC	Project Management Committee
STDF	Standards and Trade Development Facility

3. INTRODUCTION

3.1 *Background*

Mozambique has approx. 160,000 ha under coconut production mainly in the provinces of Zambezia, Inhambane, Nampula and Cabo Delgado. Zambezia province has the highest acreage of coconut with approx. 70% of the total area under the crop. Approximately 62,000 tons of copra is produced annually for export, oil production and local consumption. It is estimated that 50% of total production is consumed locally, therefore contributing significantly to nutrition and food security in rural households. About 45% of the produce is converted to copra and 5% is sold as fresh coconuts.

Currently the coconut industry is severely affected by coconut lethal yellowing disease (CLYD). It causes premature fruit fall and infected trees die within 6 months of infection. The quality of the coconuts is affected by the disease and there is a corresponding decline in annual yields. The disease has been confirmed in the central and northern regions of Mozambique.

In 2004, South Africa temporally closed its market to dried coconuts from Mozambique as a quarantine regulatory action on CLYD. Export losses per year averaged 14,000 tons valued at US $ 240 – US $ 500 per ton between 1994 and 2004. However, scientific evidence indicates that dried coconut is not a pathway for transmission of the causal agent of CLYD. Taking this into consideration, the export ban by South Africa was later lifted.

The negative impact of a declining coconut industry in the economy and employment has been a concern for the government of Mozambique. It is envisaged that a healthy coconut industry would contribute in improving food security, trade and employment. Further, rural poor households that are the majority producers of coconuts would be severely affected by the impact of CLYD.

An observation that the disease appears to be confined to the northern and central provinces provides an opportunity to identify production areas that have not yet been affected and confirming status of the disease in these areas with the aim to designate

them as CLYD - PFAs. Surveillance for lethal yellowing disease on palms is critical for establishing the pest boundaries. The knowledge and guidance drawn from the application of International Standards for Phytosanitary Measures (ISPMs) would provide credibility to results of such a survey and enable declaration and recognition CLYD-PFA.

The project MTF/MOZ/098/STF STDF 230 intended to build phytosanitary capacity for implementing International Standards for Phytosanitary Measure (ISPMs) related to establishing pest free areas (ISPM 4), pest surveillance (ISPM 6) and determination of pest status in an area (ISPM 8) in regard to management of CLYD on palms as a way of increasing market access for coconuts. In addition it would improve contribution of coconuts to food security and income generation and ultimately create a viable coconut industry for Mozambique. A survey, under this project targeted mainly the southern region of River Zambezi.

3.2 *Objectives*

The project aimed to build capacity of staff of the NPPO of Mozambique and the private sector in the various provinces of the country where coconuts are produced to satisfy phytosanitary requirements for the export of coconuts to its major international markets, create wealth at all levels, from macro-economic growth to poverty reduction at both the individual and family levels.

The specific objectives of the project were to:

i. Conduct surveys in the southern part of Mozambique in order to identify and verify areas of apparent freedom from CLYD.
ii. Identify the organisms that may act as vectors of the causal agent of CLYD.
iii. Identify the mechanisms that contribute to the severity and spread of CLYD, including host resistance and soil characteristics.
iv. Determine and initiate implementation of phytosanitary actions (legal, technical and administrative) required for establishing and maintaining pest freedom in those areas that may be designated as CLYD-PFA

v. Conduct sensitization workshops with stakeholders regarding their possible roles in maintaining CLYD – PFA if established.

4. PROJECT ACTIVITIES

The project was implemented by the Ministry of Agriculture and administered through a project Management Committee (PMC). The PMC comprised of personnel from the Ministry of Agriculture, Eduardo Mondlane University (EMU), the private sector and the IPPC Secretariat. The surveillance programme was organized and conducted specifically by a surveillance implementing team consisting of the lead phytopathologist (EMU), the lead entomologist (EMU), the head of the Plant Protection Unit, an international surveillance consultant who were supported by the provincial experts in the Ministry of Agriculture.

The main activities of the project were:

i. Project launch and stakeholders meetings
ii. Preparation of survey activities
iii. Training of pest surveillance team in surveillance methodology and related ISPMs
iv. Identification of collaborators for sample analyses and independent verification of samples (outside the country)
v. Procurement of equipment to support surveillance activities
vi. Implementation CLYD survey, vector and soil nutrient studies
vii. Analysis of results and identification of possible areas for application of phytosanitary measures to establish and / or maintain CLYD-PFA
viii. Stakeholder and project management committee meetings to discuss the findings and formulate the way forward.

4.1 *The project launch*

The project was launched at a meeting held in Inhambane province on February 12, 2010. The objective of the meeting was to present the project activities and define the roles of stakeholders in the project. Representatives of all the project beneficiaries as well as of the local government, the NGOs and the media operating in Inhambane province attended the meeting. Two further meetings were held to discuss the survey

protocols and the necessary stakeholder collaborations before the aerial and baseline ground surveys commenced.

4.2 *Preparation for survey activities*

The project team developed a protocol and a strategy for the survey with the support of, Dr Philip Swarbrick, an international consultant from University of Nottingham, UK (Plant and Crop Sciences Division) in December 2009. The consultant also supported the project team in the preparation of survey plan and review of capacity of the Biotechnology Laboratory to carry out the work anticipated under the project.

A study to review the existing data on the vectors of the causal organism was carried out in December 2009. The purpose of the study was to find out the existing information on areas with coconut trees, define their abundance and support the survey exercise.

The geographical scope of the survey was determined, taking into consideration the project objectives of determining the status of CLYD south of the Zambezi River using GIS application.

4.3 *Training of pest surveillance team in surveillance*

Training of the pest surveillance team on surveillance and related ISPMs was conducted before the baseline ground surveys were carried out. The team, including personnel from Ministry of Agriculture, private sector and collaborating partners, was trained on surveillance methodologies for effective and consistent data gathering. A total of twenty three (23) technicians participated in the training. A manual on identification and management of CLYD and protocols on pest records, CLYD tree sample collection for molecular tests, soil sampling and analysis and molecular testing were developed by the project team and used during the training. The survey protocols were discussed with other project collaborators for their improvement. A poster and a leaflet were also developed and used during surveys to raise awareness about CLYD.

4.4 *Identification of collaborators for sample analyses and independent verification of samples*

The analysis of samples was done by the Biotechnology Centre at Eduardo Mondlane University, Mozambique, based on a letter of agreement between the institution and

FAO-Mozambique. The analysis consisted of molecular assays for presence of the pest in samples from coconut trees and insects (potential vectors of CLYD) collected during the surveys. An external laboratory, CIRAD from France, was engaged by the Biotechnology Centre for validation of the results. A study to identify potential vectors of the pest was conducted by Dr. Michael Wilson, an international expert from National Museum of Wales, United Kingdom.

4.5 *Procurement of equipment for surveillance activities*

During the implementation of the project a list of equipment required for activities in surveillance work on CLYD and its vectors was made by the project team and submitted to the procurement unit of FAO-Mozambique**.**

4.6 *CLYD survey implementation, vector and soil nutrient studies*

The implementation of project activities entailed full participation of all stakeholders and partners in the coconut sector. An aerial and a baseline ground surveys were conducted for delimiting the distribution of CLYD and identifying areas intended to be declared CLYD-PFAs in the south of River Zambezi. A private company hired to perform the aerial survey conducted the activity from August 9 – 14, 2010. The baseline ground survey was conducted from September 2010 - April 2011 in all the targeted areas.

Prior to the surveys, awareness raising meetings with the stakeholders were held by the surveillance team to seek collaborations with all the players, especially farmers and community leaders. Samples from coconut trees and of soils were collected and taken to the Biotechnology Centre (UEM) and the Soil Laboratories in Eduardo Mondlane University, Mozambique (FAEF- UEM). Potential insect vectors were collected and identified by Dr. Michael Wilson from May - November 2010. During his visit to Mozambique, Dr. Michael Wilson collected insects and facilitated a training course for local personnel on the identification of potential vectors of the causal agent of CLYD. The training took place from November 29 to December 3, 2010 at the Eduardo Mondlane University (Faculty of Agronomy and Forestry Engineering and Pedagogic Complex) and was attended by 18 technicians from the provinces of Zambezia, Inhambane, Maputo and Maputo City and from other institutions such as Plant Health Department-MINAG, Faculty of Agronomy - UEM, Millennium Challenge Account (MCA)

and ACIDI/VOCA. A set of manuals and brochures was provided to each participant to help in identifying the main families of potential vectors of the causal agent of CLYD.

Awareness-raising among the public was an integral component of the implementation strategy. Awareness campaigns sensitized the public on the need for their cooperation and compliance with legal and cultural enforcement mechanisms of activities on CLYD.

4.7 *Data analysis, interpretation and identification of possible areas for application of phytosanitary measures to establish and / or maintain CLYD-PFA*

During the aerial survey, five (5) suspected CLYD infected trees were detected (3 in Inhambane and 2 in Sofala Provinces). Ground survey was therefore initiated in Inhambane, Sofala, Gaza and Maputo provinces. During the ground survey, 166 sites and 501 trees were sampled. CLYD was found to be present in the south of River Zambezi in three small locations in Xai-Xai, Vilankulo, and Machanga, in Gaza, Inhambane and Sofala provinces respectively. However, only 1% of the trees tested were confirmed to be infected with CLYD (5 out of 473). Two CLYD strains viz. Tanzanian and Ghanaian strains were found in three different locations. An additional 15 trees (3%) were suspected to be infected by a different strain as they tested positive with universal primers and showed CLYD symptoms. Further sequencing is needed to clarify these results. The three trees infected with the Tanzanian strain in Xai-Xai showed no symptoms of CLYD.

4.8 *Stakeholder meetings*

A meeting with the project stakeholders was held from August 17 – 18, 2011 in Vilankulo, Inhambane province. Forty nine (49) people from the areas targeted by the project - private sector producers, community leaders, local government representatives, and staff from academic institutions, FAO representatives and staff from NGOs attended the meeting at which the project results were presented by the project team. The results presented were specifically of the surveys from the project areas; the impact of CLYD in coconut sector and the national strategic plan for CLYD control.

Based on distribution and occurrence of CLYD, it was judged prudent not to declare the southern region a CLYD-PFA. Further surveillance and diagnostic studies were recommended to ascertain the status of the disease and minimize likelihood of its further spread.

5. RESULTS

The studies carried out under the project revealed that the incidence of CLYD is not related to soil nutrient factors.

Two species of *Diostrombus* namely *D. mkurangai* and *D. abdominalis (*Family Derbidae) were found to occur abundantly on coconuts*.* However, none of the specimens of these insects collected and tested so far has been found positive for any of the CLYD strains, though the tests are still continuing. *Diostrombus mkurangai* had tested positive in a study conducted in Tanzania and is considered to be a potential vector of the causal agent of CLYD. Further studies are needed to confirm the presence of different strains of CLYD in specimens collected in Mozambique and whether these species are actually vectors of the pest. *Diostrombus mkurangai* was the dominant species in the highly infected areas in Zambézia. However, *D. abdominalis* was the most abundant in Vilankulo.

Although only a few spots of CLYD infected trees were found during the surveys, it is advisable that an attempt to designate the area as *"an un-infested part of a country in which a limited infested area is present"* (ISPM 4) using the available information would be premature. Further surveys and confirmatory diagnostic tests are necessary. Surveillance data and the map showing the occurrence, distribution and hosts of CLYD were developed. However, identification of vectors and determination of other mechanisms of disease spread are not conclusive.

Phytosanitary measures for establishing and maintaining CLYD freedom may continue to be developed alongside the ongoing surveillance work with the possibility for ultimate use in managing CLYD – PFA if eventually established. However, given the nature of the disease and the type of coconut product traded internationally, it may be more prudent to direct further effort towards integrated management of the disease within the country so as to minimize internal spread. In this regard, efforts to ensure use of only disease free planting materials, survey to confirm the correct extent of distribution of the pest, improved capacity for disease diagnosis and identification of vectors should be given high priority.

6. RECOMMENDATIONS

Resources should be earmarked for development and implementation of integrated pest management system, enforcing phytosanitary measures such as restriction of movement of planting materials, awareness-raising campaigns and regular monitoring of the area to ensure that the disease does not spread from the spots where it has been detected to the rest of the southern region.

Several factors may be influencing the expression of symptoms of the disease. These include possible existence of different strains of the pathogen in Mozambique, variability in tolerance / resistance by the currently grown coconut cultivars and different vectoring capabilities of its insect vectors. Resources should be allocated to continue the studies initiated under this project to validate some of the attributes that can only be inferred currently from the results of the studies reported here.

The project was designed to build the national capacity to deal with CLYD including aspects on its diagnostics and surveillance. Support from external experts was necessary for good progress of the work. In the course of implementing the project important partnerships were built to leverage competencies in the surveillance and diagnostic work on CLYD and its vectors / potential vectors. It is necessary to maintain these partnerships and maximize on synergies with other projects taking place in Mozambique in an endeavour to achieve a long term management strategy for the disease.

7. REFERENCES

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