

Tomato curl stunt virus management strategies for all year round tomato production in Mozambique

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Abstract

Tomato is the most popular vegetable in the home garden all over the World as well as in Mozambique. Tomato production in Mozambique has been recently affected by *Tomato curl stunt virus* (*ToCSV*) disease, a devastating viral disease that is causing yield losses of up to 100%. The present study is a follow up of previous studies and will include *on-station* and *on farm trials* to evaluate the response of new lines and varieties to *ToCSV* in different agro ecological environments and seasons (all year around production) in Mozambique. Due to the lack of local germplasm, the lines that will be tested will come from countries where they have already been tested for *Tomato yellow leaf curl virus* (*TYLCV*) resistance, a viral disease that cause similar symptoms on tomatoes and is likely to share many biological properties with *ToCSV*. In the screening as well as in the epidemiological studies, molecular tools and techniques will be used. At least five promising resistant varieties under Mozambican conditions will be identified at the end of the project for possible release. Surveys in tomato production areas that have not been yet surveyed will also be included. The project will allow training of two MSc students and it will be a collaborative effort involving two institutions, Eduardo Mondlane University and IIAM (Instituto Investigação Agrária de Moçambique).

Key words: *Lycopersicum esculentum*, Mozambique, resistance, tomato, *tomato curl stunt virus*, , *tomato yellow leaf curl virus*

Résumé

La tomate est le légume le plus populaire dans le jardin domestique partout dans le monde aussi bien qu'au Mozambique. La production des tomates au Mozambique a été récemment affectée par la maladie *Tomato curl stunt virus* (*ToCSV*), une maladie virale dévastatrice qui cause des pertes de rendement pouvant aller jusqu'à 100%. La présente étude est un suivi des études précédentes et comprendra des essais notamment en

station et à la ferme pour évaluer la réponse de lignées et de variétés nouvelles à la maladie ToCSV dans différents environnements agro écologiques et différentes saisons (au courant de toute l'année de la production) au Mozambique. En raison du manque de matériel génétique local, les lignées qui seront testées proviennent de pays où elles ont déjà été testés pour la résistance au virus *Tomato yellow leaf curl virus* (TYLCV), une maladie virale qui cause des symptômes semblables sur les tomates et est susceptible de partager de nombreuses propriétés biologiques avec ToCSV. Dans le dépistage ainsi que dans les études épidémiologiques, les outils et techniques moléculaires seront utilisés. Au moins cinq variétés résistantes prometteuses dans les conditions du Mozambique seront identifiées à la fin du projet pour une rétention possible. Les enquêtes menées dans les zones de production de tomates qui n'ont pas encore été étudiées seront également incluses. Le projet permettra la formation de deux étudiants de maîtrise et ce sera un effort de collaboration entre deux institutions, l'Université Eduardo Mondlane et IIAM (Instituto Investigaçao Agrária de Moçambique).

Mots clés: *Lycopersicum esculentum*, Mozambique, résistance, *tomato curl stunt virus*, *tomato yellow leaf curl virus*

Background

Tomato is an important source of food and income generation in Mozambique, and the crop is grown, all year around, in areas where favourable agro climatic conditions (temperature, water and soils) for horticulture production prevail. These high potential regions include the valleys of the Incomati, Umbeluzi and Limpopo rivers in the south of Mozambique and the high altitude areas of Manica, Angonia, Lioma and Lichinga (Tembe, 1990).

The occurrence of *Tomato curl stunt virus* (ToCSV) in tomato producing areas in the country has greatly affected the crop production and is causing a negative impact on the livelihood of the producers and their dependents. So, it is important to develop effective control methods that can mitigate this disease negative economical and social impact.

Bemisia tabaci, the vector of ToSCV, has an ability to develop resistance to pesticides and has a large host ranges from cultivated plants to spontaneous weeds, making it difficult to control the spread and continuous infection on tomato. Due to this, the development of an Integrated Pest Management (IPM)

program that includes resistant or tolerant cultivars is preferred, to reduce the negative impact of the use of pesticides.

Literature Summary

During 1997 a new disease emerged in tomato production areas in the Onderberg region, South Africa. The affected tomato plants showed a foliar symptom similar to those induced by *Tomato yellow leaf curl virus* (TYLCV), including foliar chlorosis, leaf curling and reduced fruit set. Since it was first reported in 1997 (Pietersen and Smith, 2002), the disease has spread to additional tomato growing areas throughout South Africa and has also been recently identified in the southern region of Mozambique Maputo and Gaza Provinces.

Tomato Curl Stunt Virus, belonging to the *Geminiviridae* Family (*Begomovirus* genera) and transmitted by whiteflies *Bemisia tabaci*.- (South Africa: Onderberg; 1998) (ToCSV-ZA:Ond:98) has emerged as important only in the last decade. ToCSV name was based on observed field symptoms in tomato plants. This conclusion was based on analysis of nucleotide (nt) sequence of the core coat protein sequence (GenBank AF261885), which shared less than 80% nt with the most closely related begomoviruses. ToCSV has been shown to be experimentally transmissible by the B-biotype whitefly *B. tabaci*, a recent introduction to the tomato-producing region of South Africa (Brown, 2000).

Study Description

The main objectives of this study are to (a) identify and develop tomato varieties resistant to ToCSV and adapted to main tomato growing agro-ecological conditions in Mozambique; (b) evaluate the distribution, progress of the epidemic and critical period of occurrence of Tomato *Curly Stunt Virus* under field conditions in the main areas of production of tomato in the country; and (c) screen molecular markers for identification of resistant genes, to be used in breeding programs.

For the identification of ToCSV resistant varieties well adapted to the regional conditions in Mozambique and with preferred quality of fruits, tomato lines from regional breeding programs and commercially available varieties will be evaluated at 1) an *on station* trial in two sites to understand and analyse how they respond when exposed to ToCSV under Mozambican agro-ecological conditions; and 2) an *on-farm* trial in eight sites. On station trials will take place during the hot season because this is the time when white fly infestation and ToCSV infection is high. For the on-farm trials, promising lines and varieties

developed under previous projects (such as the project “Classical and Molecular breeding of tomatoes with resistance to ToCSV and related viruses in Mozambique and South Africa”) will be used, to confirm their degree of tolerance to ToCSV. Variables that will be analysed include white fly population densities, incidence of the disease (expressed in percentage), degree of severity of the disease, percentage of fruit set, yield (in ton/ha) and quality of final product (type, size, shelf life and the preference by the farmers), using participatory approach.

To evaluate the virus distribution in the major tomato production areas a survey will be conducted. These areas will include Chokwe, Boane, Namaacha, Moamba, in the South Region, Manica, Sussundenga, Angonia, Mucuba, Gurué, Mocuba, in the Centre Region and Cuamba in the North Region. In the period from November 2010 to February 2011 these areas will be sampled to know the severity of disease. Ten tomato growers in each district will be selected and their fields sampled. Variables to be analysed will include disease incidence and severity and white fly population density.

For the assessment of the critical period of occurrence of *Tomato Curly Stunt Virus*, an on-station trial will be carried out from October 2010 to September 2011 at Chókwe and Umbeluzi Agrarian Stations. The trial treatments will be 12 planting dates at a 30 days interval. Variables to be analysed will include disease incidence and severity and whitefly population densities.

Detection and identification of *Tomato Curly Stunt Virus* will be done using molecular techniques. DNA will be extracted from foliate tissue and analysed according to the Protocol described by Dellaporte *et al.* (1983) cited by Barbosa (2007). For the molecular screening of markers for identification of resistant genes to be used in breeding programs, as a follow up to previous studies, molecular markers already developed and tested for South African varieties and lines, will be tested using the germplasm from the on station variety trials. The germplasm used in these trials will be tested for viral infection using samples collected and submitted to PCR-RFLP to confirm the presence of ToCSV. Molecular markers will be used to identify the resistant genes present in varieties with no symptoms/resistant or tolerant varieties.

Awareness and training activities of extensions agents and tomato growers will be included in the project. Training will include ToCSV and its vector identification as well as good

agricultural management practices. These activities will be jointly performed by the project coordinators and the graduate M.Sc. students involved in this project. BSc Hon. students will be involved in both research and dissemination activities.

Research Application

The primary outputs of this project will include two MSc students and their research findings. This long term capacity building will contribute to improved research capacity in plant protection and tomato breeding in Mozambique.

As a result of resistant varieties that will likely be identified and knowledge gained through this project, farmers will be trained to adapt sustainable disease management practices that will improve productivity. More rural families will grow more good quality tomatoes all year around and farmers' income and tomato production and productivity will improve. Also, there will be a reduction of negative impact to the environment through reducing use of pesticides.

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