TECHNICAL INNOVATION FACTSHEET

DEVELOPMENT OF TWO SUSTAINABLE CITRUS FRUIT PRODUCTION SYSTEMS UNDER "HUANGLONGBING" CONSTRAINT IN GUADELOUPE

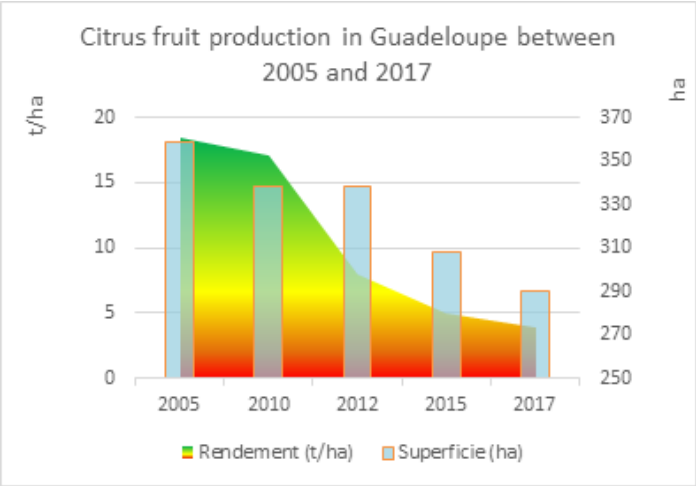
"Huanglongbing" management in Guadeloupe

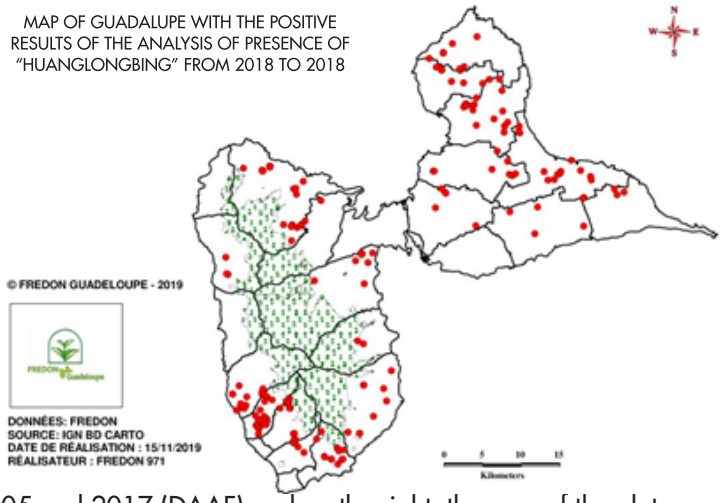
■ THE PROBLEM ADDRESSED

Restarting a sustainable citrus fruit production sector in Guadeloupe under high disease pressure

The Asian psyllid vector of '*Candidatus* Liberibacter asiaticus' was identified in Guadeloupe in 1998 (Etienne *et al.*, 1998) and citrus "huanglonging" disease was detected in 2012. As described in other countries, the disease has very bad impacts on citrus fruit production (Gottwald *et al.*, 2007). Citrus fruit production decreased from around 6,000 tonnes in 2005 to just over 1,000 tonnes in 2017. A regional epidemio-surveillance network was set up by the authorities (DAAF-FREDON) as soon as the disease was discovered to monitor the presence of the insect vector and the disease symptoms. In total, more than 60% of the plots were found infected. A map of the most contaminated areas has also been set up. As there is no curative solution, different sustainable plot management methods have been tested to propose cropping systems adapted to manage the producers' constraints.

Of the 438 analyses carried out from 2012, 264 resulted positive with about 60% of the trees tested infected. Plots detected negative before 2019 are not re-tested annually and can potentially be infected today and thus constitute new sources of infection for the disease (ANSES, 2019). Also in some plots, very few psyllids are observed but the disease is present. Many countries opt for the destruction of contaminated plants on the field (Lopes *et al.*, 2010) but due to the high cost of plants in Guadeloupe (between 15 and 25 euro/plant), this solution is not applicable, therefore, it seems essential to find a way to live with the disease.





• On the left, citrus fruit production in Guadeloupe between 2005 and 2017 (DAAF) and on the right, the map of the plots positive to "huanglongbing" between 2012 and 2018 (FREDON)

■ THE PRACTICE/INNOVATION PROPOSED BY TROPICSAFE

Development of agro-ecological and organic technical processes

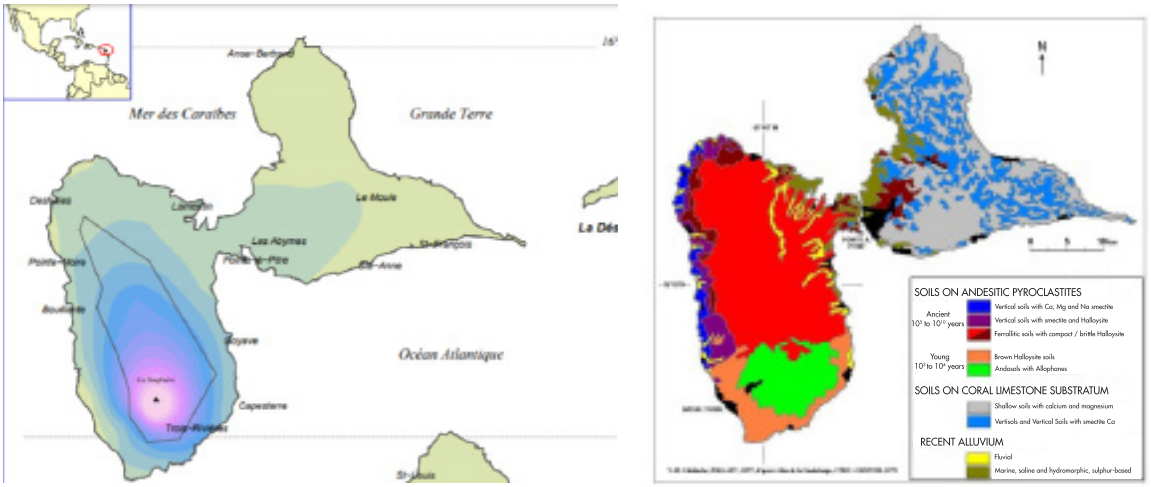
The health context related to "huanglongbing" is very complicated in Guadeloupe with very low sanitation level, or destruction of infested plots/infected trees. Only one species tolerant to the disease remains cultivated, the triploid Tahiti lime. The other species, such as oranges, mandarins, and grapefruits, are only produced in very small quantities.

The development of innovative and/or low-input technical routes more resilient to the disease is necessary for Guadeloupe. It seems essential to break with the old production system that has become inefficient and unsustainable under the constraint of this disease. Two types of cropping systems are therefore tested in an agro-ecological system

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727459

that saves on phytosanitary inputs (IPM) and in an organic system without phytosanitary treatments (BIO).

Trees infected by "huanglongbing" are more susceptible to biotic and abiotic stresses. The objective is to make these systems as efficient as possible to limit these stresses and put the trees in the best possible production conditions. The plots were planted in 2015 at Capesterre Belle Eau and Vieux Habitants to verify the combined effect of cultivation practices and plant material on trees in two different soil and climate contexts, one rather dry and hot, the other rather hot and humid.



• On the left, mean rainfall map (Météo France) and on the right, soil map (INRA)

• Pictures of the plots PA IPM (left) and PA BIO (right)

■ HOW IS TROPICSAFE IMPLEMENTING IT?

Comparison between agro-ecological and organic management

There is no visible effect of practices on disease control, but there are visible effects on the tree health. The species chosen for this experiment are diploid mandarins and tangelos, coupled with three different grafting stocks, including two tetraploid rootstock. Assessments of symptoms, pathogen presence, and tree mortality were assessed since 2015. A high level of technical expertise is required to improve irrigation practices and propose appropriate fertilization protocols that do not induce other stress except the one induced by the disease. It is also important to perform interventions according to the different stages of the trees during the year. It seems essential to determine the level of infection and vector infestation of the plots, before assessing the impact of the cropping systems on the trees. The disease was detected very quickly on the plots and the contamination rates are very high 4 years after planting. The high percentages of disease presence are also influenced by the favorable context on these plots for the insect vector: low altitude, presence of citrus fruits nearby (producers and/or individuals). The PA BIO plot managed organically by preservation was slightly less infected than the PA IPM plot. Psyllid larvae parasitized by *Tamarixia radiata* are regularly observed together with a lot of crops auxiliaries in general (chrysopes, beetles...). The plot is biologically controlled. The IPM system should allow a better tree growth.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727459

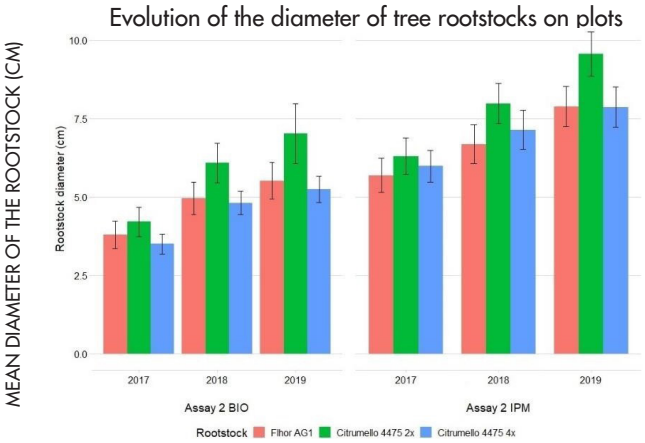
Annual growth monitoring was carried out on the plots by measuring the circumference of the trunks at the level of the rootstock (10 cm from the ground) and the variety (5 cm above the graft). This criterion was selected to determine the impact of the technical management implemented (IPM or BIO) on tree growth. This indicator will also allow selecting the most efficient rootstocks and varieties adapted to the soil and the climate. The trees on the PA IPM plot were growing faster. The IPM technical path implemented seems to allow faster tree growth than the BIO technical path.

- It should be noted that the PA BIO plot suffered numerous damages due to breakage and cutbacks in the irrigation network. The plot remained without water for several months, and this was strongly affecting the trees.

- The trees on the PA IPM plot were not pruned to limit pruning stress while those PA BIO were pruned annually since planting. A severe shape pruning was achieved in the first year of planting, delaying the growth. The tetraploid rootstock (Citrumelo 4x) had a dwarfing effect compared to diploid (Citrumelo 2x) on both plots. The study of fruit yields and quality is ongoing as production (first fruit in 2017) begins to become homogeneous in 2019. The PA IPM plot seems better than PA BIO plot.

	PA BIO	PA IPM
Plantation year	2015	2015
First HLB symptoms	End of 2016	2016
First HLB detection	2017	2016
Mortality rate of the trees in 2019	30%	0,5%
Contamination rate in 2019	89%	100%

• Evolution of the sanitary status of the plots between 2015 and 2019



• Annual growth monitoring on the plots

		Fertilisation	Irrigation	Weed management	Pest management
BIO	Type	Organic + Foliar	Aspersion	Mechanical	Biological control
	Products	Italpolina Guanito, Phénix + sheep manure + Myr Micro, Auxym, Trainer	Micro aspersion	Scrapper on the row / Gyro crusher in the inter-row	Black soap+ Vermicompost juice + effective microorganisms created produced according to a technology developed by EEPFIH at Perico - Matanzas- Cuba.
	Frequency	Monthly	Daily	Monthly	Occasional
IPM	Type	Mineral (NPK)+ Foliar	Aspersion	Mechanical	Integrated pest management
	Products	Urea, DAP, 11-11-33, 12-6-20 + Hortal, Mérol	Micro aspersion	Scrapper on the row / Mower in the inter-row area	Vertimec + Karate + Oviphyt/black soap with foliar fertiliser
	Frequency	Monthly	Daily	Monthly	Bimonthly

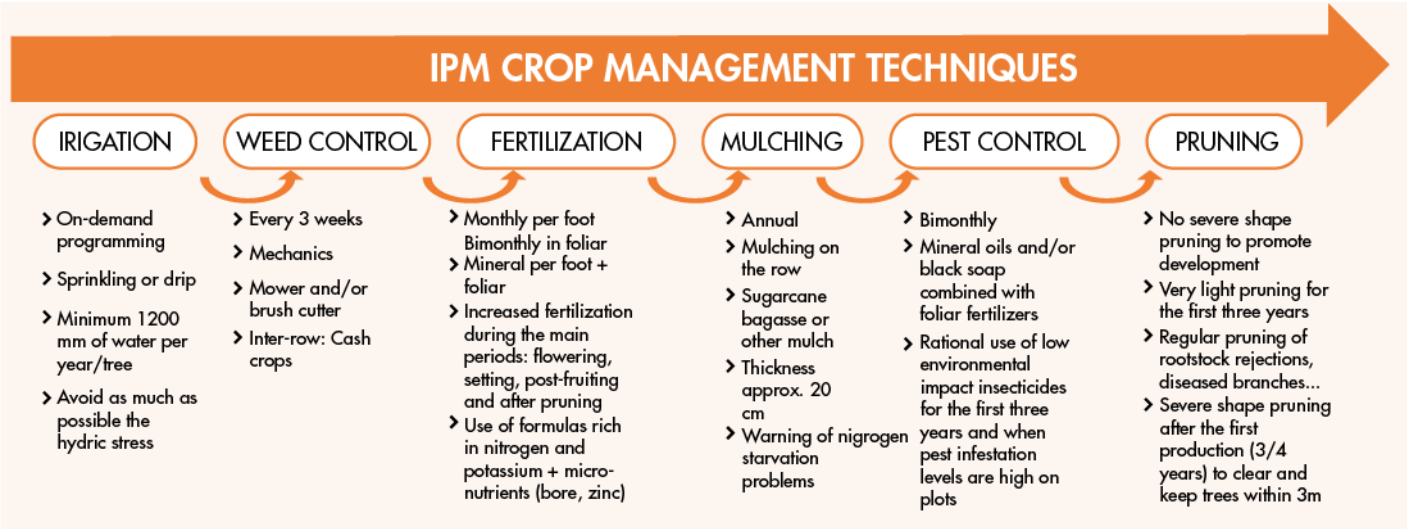
• Practices implemented on the plots

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727459

■ HOW IS IT WORKING?

Proposal of a standard IPM technical itinerary

It is known that under "huanglongbing" presence, various biotic and abiotic stresses can limit the production and even contribute to tree death. The IPM itinerary seems, therefore, the more appropriate management method. A typical IPM system is presented below. The successions and combinations of farming operations are set up to produce minimizing the tree stresses. In the context of integrated production, each operation identified in the scheme is important and should not be neglected to maintain the orchard in good shape. The IPM system had better results in the study carried out, however, it should be noted that, given the difficulties encountered in maintaining the BIO plot (water stress in particular), the results obtained are probably lower than those that would have been obtained for a system as rigorous as the IPM, but which would only use organic inputs with regular irrigation. Also, biological cultural innovations will be implemented and deserve to be validated for organic production by exclusively organic fertilization with the use of efficient micro-organisms, composts, manure regularly brought in, production of bio-organic pits at tree planting, biological intensification of the system with the addition of aromatic and/or repellent companion plants, redesign of systems by integrating other crops with economic potential to compensate the losses linked to the disease (fruit trees, banana, coffee, cocoa). A new plot was planted in November 2019 and results with be presented together with those of the BIO cropping system.



• IPM cropping system proposed in Guadeloupe

KEY WORDS

Citrus fruits, "huanglongbing", integrated pest management, agro-ecology, organic farming, cropping system

FURTHER INFORMATION

ANSES. 2019. Maladie du "huanglongbing" analyse du risque phytosanitaire pour l'Union Européenne, https://www.anses.fr/fr/content/avis-et-rapport-de-lanses-relatif-%C3%A0-une-analyse-de-risque-phytosanitaire-pour-la-maladie-du.

Direction de l'Alimentation de l'Agriculture et de la Forêt (DAAF). 2018. Annual agricultural statistics- Direction de l'Alimentation de l'Agriculture et de la Forêt (DAAF).

Étienne J., Burckhardt D., Grapin C. 1998. *Diaphorina citri* (Kuwayama) en Guadeloupe, premier signalement pour les Caraïbes (Hem., Psyllidae). *Bulletin de la Société Entomologique de France* 103, 32.

Gottwald T.R., da Graça J.V., Bassanezi R.B. 2007. Citrus "huanglongbing": the pathogen and its impact. *Plant Health Progress* 8(1), https://www.plantmanagementnetwork.org/pub/php/review/ 2007/huanglongbing/.

Lopes S.A., Bassanezi R.B., Belasque J.J., Yamamoto P.T. 2008. Management of citrus "huanglongbing" in the State of São Paulo–Brazil. *Proceedings of the FFTC-PPRI-NIFTS Joint Workshop on Management of Citrus Greening and Virus Diseases for the Rehabilitation of Citrus Industry*, 107–117.

AUTHORSHIP

Youri Uneau and **Maéva Marcin** ASSOFWI, Route du Bouchu, 97119 Vieux Habitants, Guadeloupe, France
uneau.assofwi@yahoo.fr marcin.assofwi@yahoo.com
Raphael Morillon CIRAD, Station de Roujol, 97170 Petit Bourg, Guadeloupe, France raphael.morillon@cirad.fr

April, 2020

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727459

www.tropicsafe.eu