

Coffee Disease Risk Analysis: How Epidemiology Knowledge Could Help in Assessing and Preventing Disease Invasion

D. BIEYSSE^{1*}, C. CILAS², J. MOUEN³, P. MUSOLI⁴, J. AVELINO²

¹CIRAD, UMR BGPI, TA A-54/K, 34398 Montpellier Cedex 5 France.

*E-mail: daniel.bieysse@cirad.fr

²CIRAD, UPR Bioagresseurs de pérennes, TA A-31/02, 34398 Montpellier Cedex 5, France

³IRAD, Station Polyvalente de Foubot, BP 665 Bafoussam, Cameroon

⁴NARO-COREC, PO BOX 185, Mukono, Uganda

SUMMARY

Plant diseases can be classified into two types: (i) the co-evolved diseases which have evolved with the host in its centre of origin and (ii) the new encounter diseases which have resulted from the adaptation of a native pathogen to an introduced crop. Coffee is under the threat of both kinds of diseases mainly due to increasing South-South trade. This situation could lead to the introduction to new territories of co-evolved diseases like Coffee Wilt Disease (CWD caused by *Fusarium xylarioides*) confined so far to Africa, or of encounter diseases like Coffee Berry Disease (CBD caused by *Colletotrihum kahawae*) only present in Africa and the American Leaf Spot Disease (ALSD caused by *Mycena citricolor*) located in America only. Moreover, the recent occurrence of *Xylella fastidiosa* on coffee in Brasil in 1995, causing the Coffee Leaf Scorch, points out the possibility of the emergence of new encounter diseases on the crop. Through the analysis of the historical expansion pathways of the main coffee diseases, their current distribution and the epidemiological knowledge on the pathosystems, we propose different strategies in order to prevent the introduction of diseases to new territories and to decrease the risk of wide and severe expansions in case of an introduction. A special emphasis will be given to CBD, CWD and ALS.

INTRODUCTION

Coffee is under threat of two kinds of diseases: co-evolved diseases, which have evolved with the host in its centre of origin, such as Coffee Wilt Disease, and new-encounter diseases, resulting from the adaptation of a native pathogen to an introduced crop, such as Coffee Berry Disease (only in Africa), and American Leaf Spot Disease (only in America).

DISEASES ORIGIN AND CROP LOSSES IMPORTANCE

Given the damage they cause (harvest losses, tree death, disrupted vegetative system), these 3 diseases hold back production and the replanting or extension of plantations.

COFFEE WILT DISEASE

Coffee Wilt Disease (CWD caused by *Fusarium xylarioides*, teleomorph *Gibberella xylarioides*) is a vascular disease inducing tree death in 2 to 24 months. Runoff water or upkeep operations are conducive to small-scale disease dispersal inside plots. CWD was first reported on *Coffea excelsa* in the Central African Republic in 1927 and subsequently developed on *C. canephora* in the Democratic Republic of Congo (DRC, ex-Zaire) and Ivory Coast, where losses of more than 50% were reported. After a programme of replanting with

resistant *C. canephora*, the disease became less serious, until its re-emergence in DRC in the 70s. Contemporary lines of expansion over large distances have been mainly due to road transportation of infected material to Uganda (1992), then Tanzania (1997).

COFFEE BERRY DISEASE

Coffee Berry Disease (CBD due to *Colletotrichum kahawae*) is a disease specific to *C. arabica* berries which induces 20 to 50% of crop losses. *C. kahawae* is an aerial pathogen transmitted by free water and splashing over short distances. Lines of expansion over longer distances follow roads or are due to accidental transportation of infected planting material over long distances; CBD is considered to be a new-encounter disease as it appeared for the first time in Kenya in 1922, outside the centre of origin of *C. arabica*, which is located in Ethiopia.

AMERICAN LEAF SPOT DISEASE

Mycena citricolor is a gemmiferous fungus with a broad spectrum of hosts, which probably existed on the American continent even before coffee was introduced. On coffee, American Leaf Spot Disease (ALSD) occurs on branches, leaves, and fruits. It causes heavy losses in Central America, especially in Costa Rica. Short horizontal distances for gemmae dissemination by splashing (< 60 cm) have been reported, suggesting that disease dispersal has occurred through human activities and by the introduction of infected plants in disease-free areas.

DISCUSSION

An analysis of the lines of expansion of these 3 diseases reveals a modest effect of natural factors on pathogen dispersal. The dispersal is mainly due to human activities. Especially, transportation of infected planting material over large distances and its accidental introduction have a major effect on disease emergence. So far, these 3 diseases have been confined to a single continent.

The risk of introducing one of these pathogens on a free disease continent is a serious threat to coffee culture, both economically and in terms of environmental protection. Consequently, increased surveillance needs to be developed for all producing countries, along with a quarantine service to control planting material movements, particularly in a context of intercontinental planting material exchanges.

REFERENCES

- Avelino J., Cabut S., Barboza B., Barquero M., Alfaro R., Esquivel C., Durand J.-F. and Cilas C., 2007. Topography and crop management are key factors for the development of American leaf spot epidemics on coffee in Costa Rica. *Phytopathology* 97: 1532-1542.
- Mouen Bedimo J.A., Bieysse D., Cilas C., Notteghem J.L., 2007. Spatio-temporal dynamics of arabica coffee berry disease caused by *Colletotrichum kahawae* on a plot scale. *Plant Disease* 91 (10): 1229-1236.
- Musoli C.P., Pinard F., Charrier A., Kangire A., G. M. ten Hoopen, Kabole C., Ogwang J., Bieysse D., Cilas C., 2008. Spatial and temporal analysis of coffee wilt disease caused by *Fusarium xylarioides* in *Coffea canephora*. *European Journal of Plant Pathology* [On line] DOI: 10.1007/s10658-008-9310-5.