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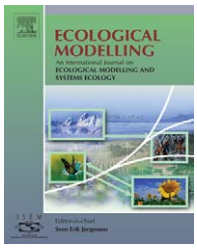

The intensity of a coffee rust epidemic is dependent on production situations

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ABSTRACT

To gain a clearer understanding of conditions conducive to the development of coffee rust and improve disease control, we monitored the development of rust epidemics in 73 plots in Honduras, over 1–3 years depending on the case, focusing on coffee tree characteristics, crop management patterns, and the environment. A simple correspondence analysis was used to show that a link could be found between certain production situations and the intensity of coffee rust epidemics. Local characteristics specific to each plantation were particularly well linked to the intensity of coffee rust epidemics, whereas regional factors such as rainfall appeared to be of secondary importance. The yield and the number of leaves of the coffee trees were positively linked to epidemic development. Soil pH and fertilisation were negatively associated with epidemic development. Shade, when it did not limit yield, probably affected the microclimate in such a way that coffee rust incidence increased. Altitude was a serious constraint in disease development. These links were illustrated by a segmentation tree, which helped to define risk domains and rationalise coffee rust control. It also provided an understanding of how intensifying Arabica cultivation, through its effects on yield and soil acidification, increased the risk of a serious coffee rust epidemic occurring.

1. Introduction

Coffee rust, caused by *Hemileia vastatrix*, is one of the main diseases of Arabica coffee trees in Latin America. It is effectively controlled by particularly using copper fungicides, applied as a preventive measure following stereotyped treatment timetables (Avelino and Savary, 2002). However, it is becoming increasingly necessary to implement rational and optimised control of this disease, due to low coffee prices and pollution problems. Kushalappa and co-workers in Brazil have developed the only tool for managing this disease that is currently available (Kushalappa et al., 1983, 1984, 1986). It can be used to predict the risk of an epidemic, based on a systematic assessment of the amount of inoculum and of certain characteristics

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of the host, or even of the microclimate in the most complex system. Fungicide spraying is recommended as soon as the risk is considered to be serious. However, in practice this useful tool does not appear to be used, probably because it is difficult to manage.

We feel that the risk of an epidemic could be assessed simply, by considering that an epidemic is the outcome of a risk associated with the characteristics of the region, primarily with the climate, but also with the soil that seems to affect coffee rust (Lamouroux et al., 1995; Avelino, 1999), and of a risk attributable to local conditions, i.e. a risk primarily linked to the characteristics of the plant, but also to crop management patterns, and especially shade management, which are known to act on coffee tree plantations microclimate (Avelino et al., 2004; DaMatta, 2004). In other words, the risk of an epidemic would depend on production situations (De Wit, 1982). This hypothesis (Avelino et al., 2004) is based on results of studies carried out on groundnut in West Africa (Savary, 1987a, 1987b) and on rice in tropical Asia (Savary et al., 2000).

In our study, we demonstrated first of all that links could be found between production situations, characterised through a survey conducted in Honduras, and coffee rust intensities. We then defined simplified risk domains, based on certain characteristics of coffee plantations and coffee trees, which were easy to measure, and which appeared to be important through their links with the disease.

2. Materials and methods

2.1. *Agrobiological context of the survey*

For this investigation, some characteristics of coffee growing in Honduras were especially favourable.

In Honduras, *Coffea arabica* is the only cultivated species. It is assumed that almost 100% of coffee varieties are Typica or Bourbon types, and their dwarf derivatives Caturra and Catuai (Avelino, 1999). Those varieties are thus genetically very similar. They only have one resistance factor, S_H5, and are vulnerable to most of the known coffee rust races (Rodrigues et al., 1975). Therefore, genetic resistance could not be a source of variation of the attack levels.

In Central America, and especially in Honduras, coffee rust genetic variability is very low. Until 1997, all coffee rust samples from Central America, studied in the Centro de Investigaçao das Ferrugens do Cafeeiro (CIFC, Portugal), which held a complete collection of differential hosts, were identified as samples of race II (Rodrigues Jr., pers. commun.). Race II holds only one virulence factor, v_5 (Rodrigues et al., 1975). In our study, we collected 27 coffee rust samples in various sites of the survey. Twenty-one samples belonged to race II. Only six samples, from the lake Yojoa region (Fig. 1), were found to contain race I, probably mixed with race II (Avelino, 1999). Although race I holds virulence factors v_2 and v_5 (Rodrigues et al., 1975), it seems less aggressive than race II (Gil, 1988). So, the physiological race factor should not be a source of variation of the attack levels either.

Honduran coffee is still partially produced from old plantations established with tall varieties, with a low productivity and a low level of maintenance. This type of plantation was not considered in this work, because we assumed that coffee rust was not a limiting factor, as was the crop management. On the other hand, a growing part of the coffee area is being planted with dwarf varieties. These varieties allow using high planting densities and usually represent the first step towards intensification. Generally, and mainly for economical reasons, the producers put into practice only part of the available recommendations. This is why one can find varied crop management patterns (Avelino, 1999). The nature and density of shade trees

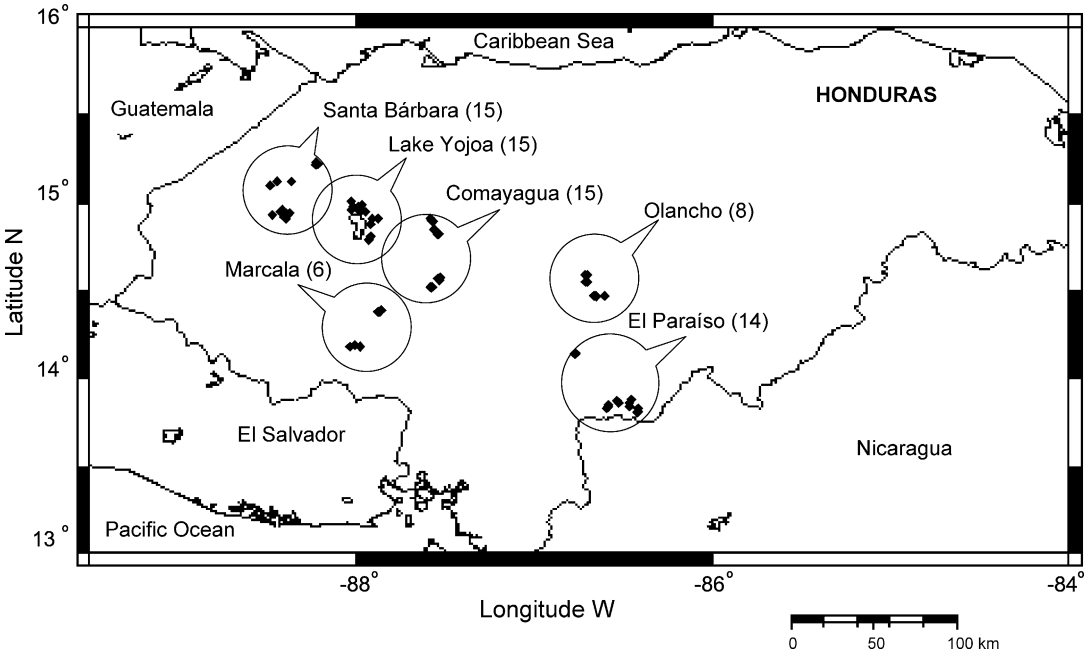

Fig. 1 – Geographical location of the 73 sampled plots (black diamonds) during the coffee rust survey conducted in Honduras, and their number per region (in parentheses).