



Performance of 10 *Hevea brasiliensis* clones in Ecuador, under South American Leaf Blight escape conditions



Franck Rivano^{a,*}, John Vera^b, Victor Cevallos^c, Diana Almeida^c, Lucrecia Maldonado^c, Albert Flori^a

^a CIRAD, UPR Systèmes de pérennes, F-34398 Montpellier, France

^b INIAP, Estación Experimental Tropical de Pichilingue, Km 5 vía Quevedo-el Empalme, Quevedo, Ecuador

^c INIAP, Estación Experimental Santo Domingo, Km 38 vía Santo Domingo-La Concordia, Ecuador

ARTICLE INFO

Article history:

Received 13 May 2016

Received in revised form

12 September 2016

Accepted 14 September 2016

Keywords:

Hevea brasiliensis

Pseudocercospora ulei

Microcyclus ulei

Escape area

Phenology

Ecuador

ABSTRACT

Rubber (*Hevea brasiliensis*) growing in Latin America is severely limited by South American Leaf Blight, a disease caused by the Ascomycete fungus *Microcyclus ulei*, recently renamed *Pseudocercospora ulei*. Sustainable ways of controlling it may be genetic, using resistant cultivars, or may consist in seeking so-called “escape zones”, where disease incidence is low thanks to climatic conditions unsuitable for the fungus. After identifying one such zone on the Pacific coast of Ecuador, between 2006 and 2014 we used an 8.2 ha trial to compare the agronomic performance of ten rubber clones originating from Asia and Africa. The study focused on tree growth, susceptibility to the disease and clone phenology. For most of the assessed clones, the results obtained over 8 months showed good adaptability and a good agronomic performance during the immature period, so that tapping could begin on the earliest trees at 6½ years. An examination of the monthly values for climatic factors such as rainfall, relative humidity, minimum temperature and dew point temperature, showed that conditions during the dry season, which lasted 5 months, were detrimental to *P. ulei* fungus development, even though the mean relative humidity of the driest months did not fall below 75%. In addition, between September and December, the minimum temperature remained above the dew point temperature, preventing dew formation on the leaf surface. These conditions enabled the trees to complete their natural refoliation without any risk of parasite pressure, and to conserve a foliar density over 90% up to natural defoliation the following year. The results obtained during the early growing phase, i.e. the immature phase, confirmed the suitability of this zone for rubber growing, especially for materials with a high yield potential, despite their known susceptibility to the disease. These escape zones consequently offer an undeniable alternative for developing rubber, due to a low phytosanitary risk arising from *P. ulei*.

© 2016 Elsevier B.V. All rights reserved.

1. Introduction

When the rubber tree moved from the Amazon Basin, where it originated, to Southeast Asia at the end of the 19th century, rubber growing underwent considerable development for more than a century in that region of the world, which today provides 93% of total natural rubber production estimated at 12.1 million tons, while Latin America produces only 3% and Africa 4% (IRSG, 2014). This somewhat paradoxical situation can be explained by the existence of a disease endemic to the South American continent, South American Leaf Blight (SALB), caused by the fungus *Microcyclus ulei*,

which has now been renamed *Pseudocercospora ulei* by Hora et al. (2014). This parasite only attacks young leaves, causing repeated defoliation until the trees are exhausted and die. The fungus continues its cycle on mature leaves that escape abscission, developing its asexual form which produces ascospores capable of infecting new leaves again. The biology of the pathogen and the epidemiology of the disease have been described by several authors (Holliday, 1970; Chee and Holliday, 1986; Gasparotto et al., 1991; Guyot et al., 2008, 2010, 2014), while the diversity of the pathogen, which is able to develop a very large number of physiological races, has also been abundantly studied (Junqueira et al., 1986, 1988; Hashim and De Almeida, 1987; Rivano, 1997; Mattos et al., 2003; Barrès et al., 2009, 2012).

The disease has yet to be reported outside Latin America, but if it were to appear on the other continents, the consequences

* Corresponding author.

E-mail address: franck.rivano@cirad.fr (F. Rivano).

Table 1

Plant material description: the ten rubber tree clones tested at Pichilingue Station, Quevedo, Ecuador, 2006–2014.

Clone	Country of Origin and rubber research institute	Parents (Female × Male)
PB 280	Prang Besar, Malaysia	PBIG × seedling
PB 312	Prang Besar, Malaysia	RRIM 600 × PB 235
PB 314	Prang Besar, Malaysia	RRIM 600 × PB 235
PR 255	Proefstation v. rubber, Java-Indonesia	TJIR 1 × PR 107
RRIC 100	Rubber Research Institute of Ceylan, Sri-Lanka	RRIC 52 × PB 86
RRIM 600	Rubber Research Institute of Malaysia	TJIR 1 × PB 86
IRCA 18	Institut de recherches sur le Caoutchouc, Côte d'Ivoire	PB 5/51 × RRIM 605
IRCA 19	Institut de recherches sur le Caoutchouc, Côte d'Ivoire	PB 5/51 × RRIM 605
IRCA 41	Institut de recherches sur le Caoutchouc, Côte d'Ivoire	GT 1 × PB 5/51
IRCA 109	Institut de recherches sur le Caoutchouc, Côte d'Ivoire	PB 5/51 × RRIM 600

would be disastrous and lead in just a few years to a substantial reduction in world natural rubber production, which would have a major economic impact on some 20 million people who depend either directly or indirectly on the rubber supply chain. Rubber growing has always been limited in Latin America, despite the explosion in demand for natural rubber since the end of the 19th century, because SALB has been a powerful brake on developing large estate projects such as Fordlandia in Brazil (Chee and Holliday, 1986; Webster and Baulkwill, 1989). Unfortunately, the research programmes undertaken in Central America and Brazil to find sustainable solutions drew a blank. Indeed, by developing new races the pathogen has succeeded in overcoming the resistance developed by breeders (Miller, 1966; Holliday, 1970; Junqueira et al., 1986; Hashim and De Almeida, 1987). Nonetheless, some new solutions are now being proposed with a view to viable rubber growing on that continent. First of all, genetic improvement research resumed in the 1980s in Brazil led to the selection and creation of material with durable resistance and satisfactory yields (Le Guen et al., 2002, 2008; Garcia et al., 2004; Rivano et al., 2013; Cardoso et al., 2014). It was also in Brazil in the 1960s that research was launched to identify zones where rubber growing was possible and where fungus pressure was less. These low phytosanitary risk zones, called escape zones, were identified and mapped (Ortolani et al., 1983; Camargo et al., 2003; Pilau et al., 2007). It was thus possible to move rubber growing from its original zone towards more suitable areas, but located further south, mostly in the State of Sao Paulo, but also in Mato Grosso, Minas Gerais, Goias, Rio de Janeiro and Espirito Santo (IBGE, 2010). Such regions have sub-optimum climatic conditions, with a fairly marked dry season that can last up to 5 months, during which the fungus cycle is interrupted and trees can escape from the disease, notably during the natural defoliation-refoliation period. Given the low parasite pressure, these regions offer the possibility of growing certain clones bred on other continents for their high production potential, which was heretofore unimaginable in Latin America. Guatemala is an example of a rubber growing country which set up its first plantations on the Pacific coast, and as chance would have it in an escape zone, after World War II (Rivano et al., 1996). Given the success encountered, rubber growing continued to expand in that part of the country, in which 90% of the 100,000 ha planted are concentrated (IRSG, 2014). Some other countries have used the same methodology as that developed in Brazil to map such escape zones. This is the case in Colombia, where 890,000 ha of escape zones were identified (Castañeda, 1997), and also in Ecuador where 80,000 ha were mapped on the Pacific coast (Rivano et al., 2015).

It is thus that in 2006 we set up an experimental plot with 10 rubber clones at the agricultural research station belonging to INIAP (Instituto Nacional de Investigaciones Agropecuarias) located near Quevedo in Ecuador, on a large enough scale to test their growth, their reaction to SALB, their phenology and, lastly, to assess their latex production over a period of 5–10 years. The purpose of the study was to confirm the potential of this escape zone for rubber,

during the immature phase, and the adaptability of these high-production potential clones under these agro-climatic conditions. The next step will consist in assessing the production of the clones, so as to draw up clonal recommendations for developing rubber growing in the region.

2. Material and methods

2.1. Trial site

The experimental plot was planted between March and April 2006, at the Pichilingue tropical experimental station belonging to INIAP (Instituto Nacional de Investigaciones Agropecuarias), located at km 5 on the Quevedo-El Empalme road, Quevedo Canton, Los Rios province (elevation 75 m, 01°05' South, 79°28' West), on the Pacific coast. The trial was set up on former grasslands, with a moderately undulating topography and a very fertile soil. The Pichilingue station lies in a zone identified as being an escape zone and which has a very marked 5-month dry season (Rivano et al., 2015).

2.2. Plant material

The 10 rubber clones used in this trial were clones of Asian or African origin without SALB resistance, but with a very good production level compared to South American clones. The pedigree of the clones is presented in Table 1. The assessments of agronomists and breeders, along with their degree of dissemination and the areas planted worldwide, indicate that these clones belong to different physiological classes (Compagnon, 1986). Clone RRIM 600 was chosen as the control as it is the one most widely planted in escape zones in Guatemala, and in Sao Paulo State, in Brazil (Gonçalves et al., 2011).

2.3. Experimental design

Our trial comprised 10 treatments (clones) and 4 replications randomly arranged in Fisher blocks, with 80 trees per replicate and per clone. The planting spacing was 7.0 m × 2.80 m, giving a density of 510 trees per hectare, for a total trial area of 8.24 ha. The area of each unit plot was 1564 m², corresponding to 80 trees organized in 4 rows of 20 trees. The trial was surrounded by two rows of clone RRIM 600.

2.4. Climate

The climatic conditions corresponded to the humid tropical region, with annual rainfall of 1993 mm, a temperature of 24.7 °C and a relative humidity of 85% (average 2005–2014). Daily temperature, relative humidity, water vapour pressure, dew point, sunshine, evaporation, rainfall, wind speed and cloud cover data were provided by the INAMHI weather station (Instituto Nacional

Download English Version:

<https://daneshyari.com/en/article/6375450>

Download Persian Version:

<https://daneshyari.com/article/6375450>

[Daneshyari.com](https://daneshyari.com)