Designing innovative spatial strategies to control black leaf streak disease of banana through modelling approach

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DESIGNING INNOVATIVE SPATIAL STRATEGIES TO CONTROL BLACK LEAF STREAK DISEASE OF BANANA THROUGH MODELLING APPROACH

Catherine **Abadie**[1,2,5], Eduardo Corrales[2], Béranger Decouture[1,2], Marta Zaffaroni[3], Jean-François Rey[3], José Guzmán[4], Edgar Valverde [4], Nancy Chaves[4], Loup Rimbaud[3]. *catherine.abadie@cirad.fr*

[1]CIRAD-PHIM, Costa Rica; [2]CATIE, Turrialba, Costa-Rica; [3]INRAE, Avignon, France; [4]CORBANA, Costa-Rica ; [5]PHIM, University of Montpellier, CIRAD, INRAE, Institut Agro, IRD, F-34398 Montpellier, France

Objectives. As experimentations are not possible at large scale, the aim of the study is to assess the efficacy of innovative strategies to reduce fungicide use to manage Black Leaf Streak Disease (BLSD) of banana by using a modeling approach. Two different spatio-temporal strategies are evaluated on a real production landscape :(i) one directly based on fungicide strategies ; (ii) one based on the cultivation of resistant cultivars

Methods

The generic epidemiological spatially-explicit **model** *landsepi* (Rimbaud *et al*.,2018) was adapted to simulate BLSD by modifying plant growth to banana and 30 BLSD parameters. 52 spatial-temporal strategies were defined (Figure 1) to **reduce the index of fungicide** treatments: (1) with a direct fungicide reduction by reducing application frequency (5,10,15,20 days), the dose (25,50,75, 100%) or the spatial coverage (in line, at 25, 50, 75, 100%) representing 160 combinations of scenarios ; (2) by replacing the susceptible commercial variety by resistant varieties in 3 spatial allocations (line, mosaic or mixture) and modifying the 4 resistance genes efficacies representing 288 combinations. Each combinations was simulated 30 times **on a real 347-ha banana production basin** (Finca San Pablo in Costa-Rica, Figure 2). The exported yield and BLSD severity (Area Under Disease Curve Progress) provided by the simulated scenarios during 10 years will be compared.

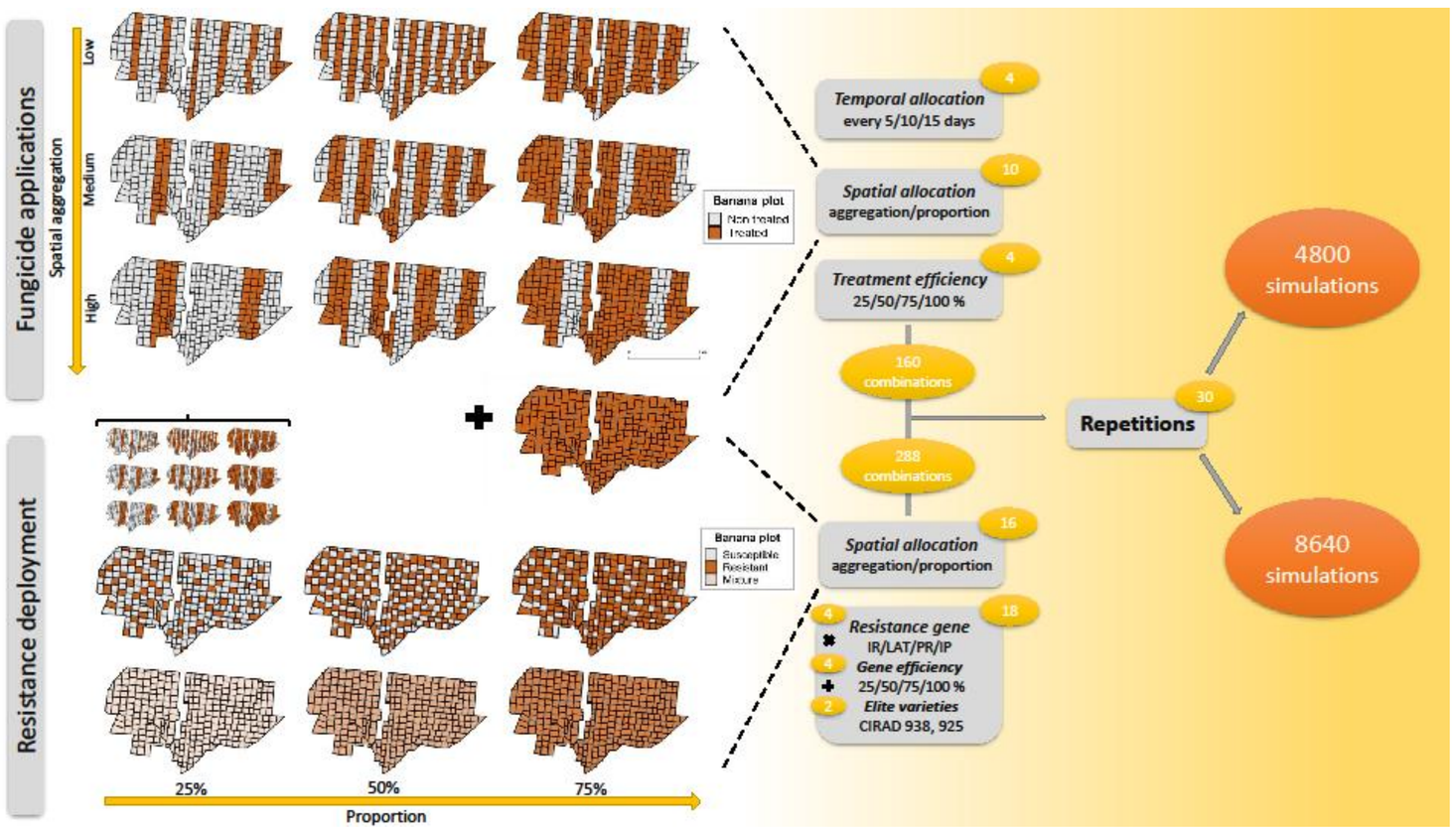

Fig. 1. 488 combinations of scenarios to reduce fungicides (i) by reducing fungicide coverage, application frequency and fungicide doses, (ii) by using resistant varieties in line, mosaic or in mixture with susceptible variety. White and orange polygons represent non-treated and treated plots (with fungicide application or using cultivar resistance).

Results. The model simulates realistic curves. The parametrization of the *landsepi* model for BLSD allowed to obtain realistic curves of dynamics of the 4 compartments (Healthy, Latent, Infectious, Removed) with BLSD severity of 0,38 and an exported yield of 0,2 $t.ha^{-1}.season^{-1}$ for 100% susceptible variety without any fungicide (Fig. 3)

Fig. 2: Aerial photography of the Finca San Pablo with 295 plots (347ha), Costa-Rica

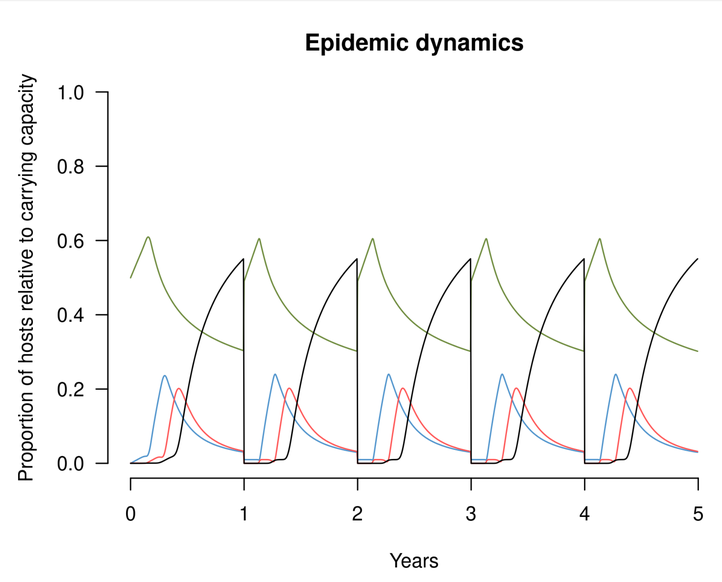

Fig 3: BLSD dynamics in 347 ha of susceptible banana without control during 5 years.

Perspectives. The **13440 simulations outputs** are statistically analysed to allow to identify at 350 ha scale the **best scenarios of direct and indirect fungicide reduction** to manage BLSD while sustaining acceptable yields.

Rimbaud L et al. (2018) Assessing the durability and efficiency of landscape-based strategies to deploy plant resistance to pathogens. PLoSComputBiol14(4): e1006067