APPENDIX B: sensitivity analysis

Sensitivity analyses were performed to know how model output variables respond to input variables.

The outputs variables chosen to study input variables were :

- 1) the insect dispersal at a perception threshold as a function of time steps
- 2) the population growth as a function of time steps

The insect dispersal at a perception threshold as a function of time steps represents the number of cells with more than 10 insects at each time step. This criteria was chosen to represent on farm possible insect detection threshold.

The population growth as a function of time steps represents the average number of insects per cell at each time step.

1. Sensitivity analysis on mortality rate

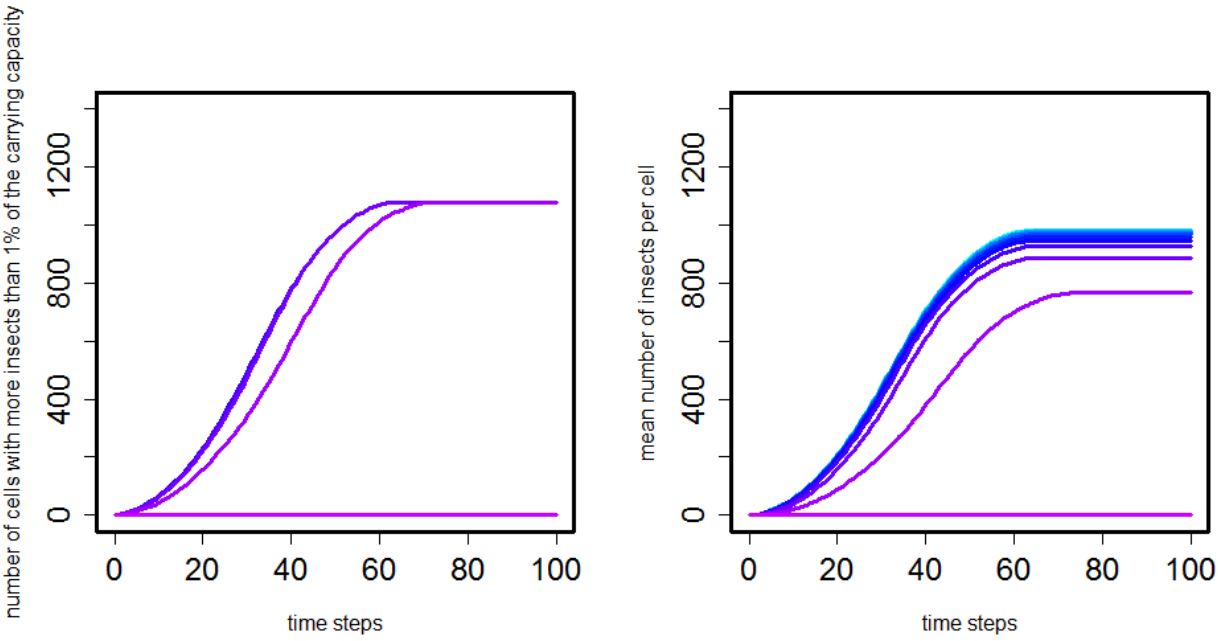

Figure 1. Sensitivity analysis on mortality rate from 0 to 1 by 0.1 (from cyan to violet)

Figure 1 shows that no measurable effect of mortality on dispersal speed was found when mortality rate is lower than 0.8. The same observation can be made on population growth.

Combining crude mortality, temperature dependent mortality and precipitation mortality, and considering temperatures in natural insect environment, we observe that mortality rate is frequently between 0.8 and 1, a range at which both population growth and dispersal speed are strongly affected. However, uncertainties are limited because we used published articles and laboratory experiments to parameterize the model optimally.

2. Sensitivity analysis on dispersal per diffusion

Rather than presenting each sensitivity analysis, we fixed parameters according to available literature and knowledge, modeling the known phenomenon of the insect dispersal. Then we studied what was the influence of effective dispersal rate on dispersal speed.

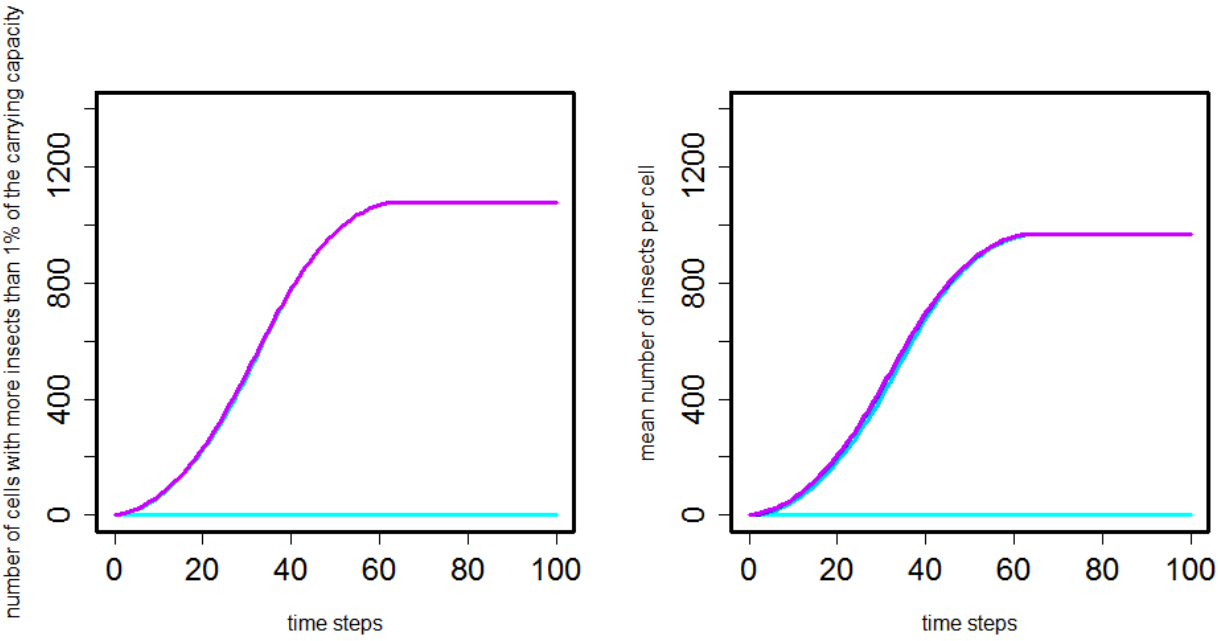

Figure 2. Sensitivity analysis on dispersal rate from 0 to 1 by 0.1 (from cyan to violet)

Here we consider that an insect can only fly from a cell to another situated in its direct neighborhood.

Under this assumption, there is no significant difference between a dispersal rate of 0.1 and 1 performed on an homogeneous environment, i.e. dispersal rate don't have an effect on dispersal speed due to the exponential rate of growth. It means that inoculum itself should have little influence on model outputs. This leads us to a necessary sensitivity analysis on inoculum.

3. Sensitivity analysis on insect inoculum

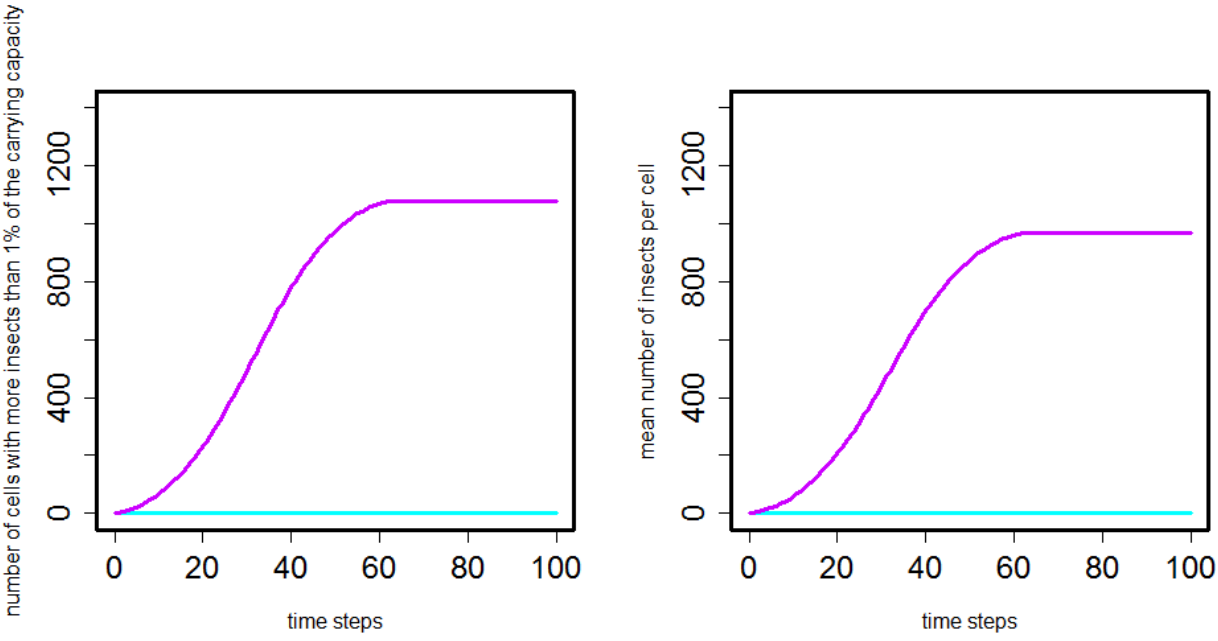

Figure 3. Sensitivity analysis on inoculum ranging from 0 to 1000 by 100 (from cyan to violet)

From Figure 3, we can observe that inoculum has effectively no observable effect nor on dispersal speed nor on population growth, as hypothesized in section 2.2.

4. Sensitivity analysis on insect carrying capacity

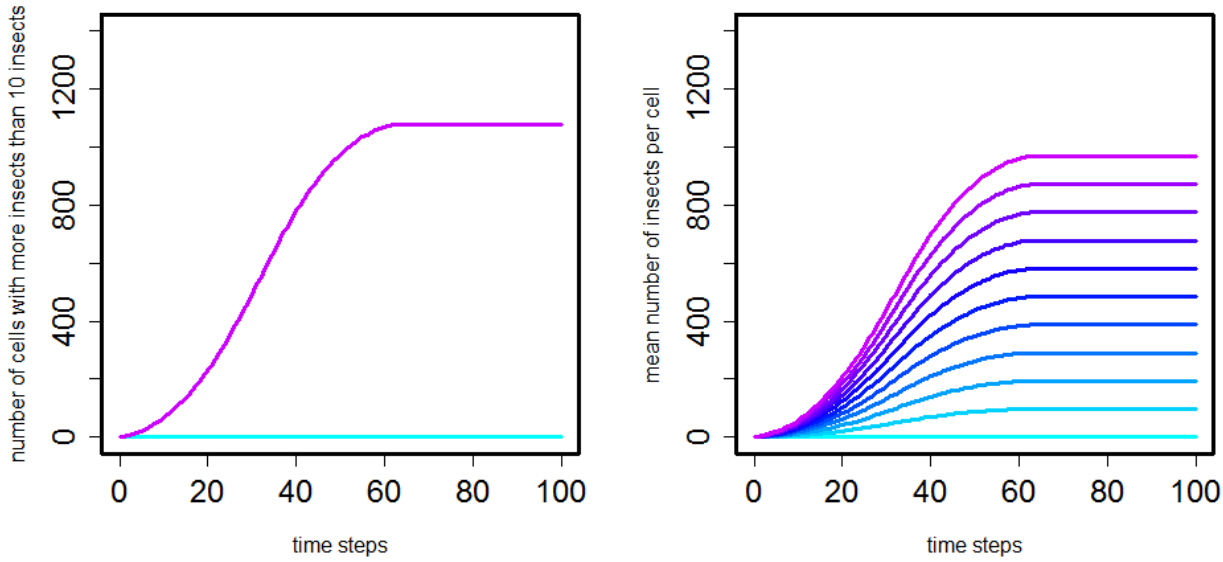

Figure 4. Sensitivity analysis on carrying capacity ranging from 0 to 1000 by 100 (from cyan to violet)

The carrying capacity has no observable effect on dispersal speed, but strongly influence population growth. It was expected as it's a limitant parameter in population growth