



## **A Bioeconomic Model to Train Interdisciplinary Research on Reducing Phytosanitary Operations in the Vineyards**

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Vine growers consume about 25% of the pesticides used in France while vineyards' area is 3% of the farmland. Sprayed products are mostly fungicides. The development of fungal pathogens is climate dependant and polycyclic, and outbreaks are difficult to handle. Thus, growers have developed intensive and mostly preventive crop protection techniques.

A traditional method in Integrated Pest Management is to define decision thresholds linking disease incidence or severity to damages. Such thresholds are then used to schedule spraying operations. These thresholds are particularly difficult to determine in the case of vine pathogens, due to specific epidemic profiles and potentially massive crop damage. French vineyards are especially vulnerable because only traditional, non-resistant, cultivars are allowed for wine with controlled designation of origin. Optimal protection strategies being yet out of reach, innovative and environment-friendly pest management for these diseases have to be developed using expertise. In order to investigate economic means to favour environment-friendly pest management in the vineyards, we have set up a bioeconomic model.

Our purpose is to explore theoretically, within an interdisciplinary approach, different routes to reduce fungicide use through a simulation model of a wine growing estate. Among all processes involved, the model was focused on the growth of the vines and the development of the disease. This system reacts to the inputs of: a climatic scenario, a primary contaminations scenario and the sprayings of pesticides. Different technical routes for sprayings can be specified, from periodic schedules to disease adapted behaviour through pressure estimation in the vineyard. The outputs are the quality and quantity of the harvest and the economic output of the estate.

We have used several methods to build the model. We first ran a bibliographical study topped with expert knowledge elicitation of the disease dynamics. We have considered so far powdery and downy mildew. The state of the system is defined at the plot level. To fit the parameters for the dynamics, we used both historical data available at our laboratories and surveys conducted in four Bordeaux vineyards in 2006. These surveys included development of epidemics and operational costs. Expert assumptions were made about the relation between quality, quantity and actual economic value of the harvest.

The model will enable us to explore different crop protection strategies and their economic impact according to climate scenario. Our ultimate aim is to determine which policies should be used to drive the growers towards a significant reduction in the number of spraying operations. As of now, we have restricted our study to the case of Bordeaux wines, but the bioeconomic modelling is generic enough to cope with other vineyards, provided parameterization data for "terroir" and technical practices are available. The costs and incomes are analysed on a differential basis, so that precise modelling of all aspects of vine growing are not necessary.