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Spatiotemporal modelling of Esca complex grapevine disease at vineyard scale. S. Li 1,2, Y. Cao 1,2, D. Morais 1,2, S. Bastien 1,2, V. Bonnardot 3, A. Gegout-Petit 4 and L. Guérin-Dubrana 1,2.

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Esca complex is a disease that represents one of the major threats to viticulture around the world. To better understand the underlying process of the spread of esca, in particular surveying expression of foliar symptoms (Grapevine Leaf Stripe Disease and apoplectic foliar symptoms) and the environmental risk factors associated with this disease, we carried out quantitative analyses of its spatiotemporal development at vineyard scale. In the first step, non-parametric statistical tests, based on join count statistics were developed in order to assess the capacity of the disease to spread within vineyards of the Bordeaux region.

Data from over 8 years of annual records, containing between 1200 and 2300 contiguous Cabernet Sauvignon vines from 15 mature vineyards were used. Among vineyards, a large range of spatial patterns, from random to strongly structured, associated with various prevalence, were found. In the vineyards with strongly aggregated patterns, there was no significant increase in the size of the clusters over time. These results, associated with those from the analysis of the closed spatial dependence between previously and newly symptomatic vines, suggested a limited potential for secondary local spread from neighboring symptomatic vines. Consequently, in the second step, to test the effect of the environment in the disease spread, we applied spatiotemporal logistic regression models which explicitly accounted for both local environmental covariates and spatiotemporal correlation. The Bayesian inferences of these models were performed by using the INLA (Inverse Nested Laplace Approximation) approach. The models were assessed using the spatiotemporal data from three vineyards showing a strongly structured spatial pattern, and including covariates, such as climatic indicators and physiological plant indicators. The results showed the effect of both environmental factors and physiological indicators on the occurrence of esca complex symptoms.

The research opened perspectives for risk prediction and recommendations of specific control strategies to prevent the spread of esca.