A spatiotemporal epidemiological model for studying disease progression in plants.

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Abstract

In the study of plant disease epidemics, it is essential to consider both the state of each individual in the population and their spatial location when modeling disease spread. In this contribution we introduce a model to describe plant disease spread, where the infection of a susceptible individual is influenced by the transmission rate from infected individuals and spatial correlation. The spatial correlation is modeled using the Matérn correlation function, which incorporates spatial dependence based on distance. We applied this model to almond leaf scorch disease, caused by the bacterium *Xylella fastidiosa*, to analyze the behavior of model parameters and variability due to the characteristics and location of the initial disease introduction using a simulation algorithm. Our findings showed that the range parameter of the Matérn correlation, indicating the distance at which two observations are considered spatially uncorrelated, and the initial introduction point of the disease, had the greatest impact on the variability of the results. Additionally, the spatial distribution of individuals played a crucial role in disease spread, with areas lacking trees serving as barriers when their extent surpassed the range parameter. This individual-based model is versatile and can be applied to other plant diseases by adjusting the parameters to match their specific epidemiological traits.

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References

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