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impede pathogen movement at the xylem level. The distribution of infection severity of cuttings across the range of genotype's susceptibility suggests that a risk-based mechanism is involved. We used this experimental data to calibrate a mechanistic stochastic model of the pathogen spread and we provide evidence that the efficiency of the compartmentalization process within a given xylem vessel is a function of its diameter.

KEYWORDS

grapevine, mechanistic model, plant, tolerance, xylem anatomy

1 | INTRODUCTION

Diseases caused by vascular pathogens encompass many annual and perennial plant species and can be particularly detrimental for both agriculture and natural ecosystems (Gramaje et al., 2016; Liebhold et al., 2017; Showalter et al., 2018). As these pathogens colonize the vascular system, the xylem conductivity of the host progressively decreases due to the occlusion of vessels by tyloses and gels triggered by the host in order to compartmentalize the infection (Pearce, 1996; Yadeta & Thomma, 2013). This loss of hydraulic conductivity has negative effects on the plant and according to the extent of infection can ultimately lead to plant death (Deyett et al., 2019; Inch & Ploetz, 2012). Because vascular pathogens reside in the wood, the use of curative management strategies are usually difficult to implement or ineffective (Ačimović, Martin, Turcotte, Meredith, & Munck, 2019; Jiménez-Díaz et al., 2011; Mondello et al., 2017). Control strategies preventing the infection can sometimes be used, but the planting of tolerant or resistant genotypes appears to be a more sustainable long-term approach (Jiménez-Díaz et al., 2011; Sniezko & Koch, 2017).

Xylem is a complex and heterogeneous tissue where the spatio-temporal organization of defences also plays a pivotal role in the ability of the host to wall-off microbial attacks (Beckman & Roberts, 1995;