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Early detection surveillance for Huanglongbing in a plantation; from theory to practice

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The detection of a new HLB epidemic in a planting often occurs when the disease has already reached high incidence. This is problematic and once the epidemic has become established it is difficult to recover the economic productivity of the grove. However, if new epidemics can be detected early enough then more can be done to control the disease. Early detection requires that surveillance surveys be in place before the disease arrives; that is, a number of trees within a healthy grove should be inspected at regular intervals for symptoms of HLB. Exactly how many trees should be surveyed and how frequently this should be done is a non-trivial problem and one that has not previously been addressed in plant pathology. We present a theoretical method that relates the dynamics of an invading epidemic to the dynamics of a monitoring program. The method determines exactly how an early detection survey should be designed in order to achieve a high probability of detecting an epidemic whilst it is at an early stage. We compare the theoretical method to a complex simulation model which replicates the spatial and temporal dynamics of HLB in the field. By running the model thousands of times we can make probabilistic predictions on early detection survey design that can be directly compared with the theoretical method. We find striking similarities between the simple theoretical and more complicated simulation approach that enables us to make valuable new insights as well as deliver methods for transfer into practice.