



Modelling citrus Huanglongbing spread as affected by alternative hosts, vector populations and roguing

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The disease known as Huanglongbing (HLB) is currently the greatest concern among citrus growers. Caused by the bacteria *Candidatus Liberibacter* spp., it is transmitted by *Diaphorina citri* psyllids, which acquires the bacteria by feeding on infected plants. HLB is incurable and affects all citrus varieties. The orange jasmine (*Murraya paniculata*) is an ornamental plant widely found in Brazilian urban landscapes, and host of both the bacteria and their vector. Considering the available scientific results, the role of orange jasmine in a given HLB epidemic is controversial as it is a good host for the vector, but an inadequate one for the pathogen. The objective of this work was to model the spread of HLB considering the presence of a population of alternative hosts. We developed a compartmental deterministic mathematical model for representing the dynamics of HLB disease in a citrus orchard, including delays in the latency and incubation phases of the disease in the plants and a delay period on the nymphal stage of *D. citri*, the insect vector of HLB in Brazil. The results of numerical simulations indicate that in the absence of disease/vector control alternative hosts should not play a crucial role on HLB dynamics considering a typical scenario for the Recôncavo Baiano region in Brazil. In addition, the current policy of removing symptomatic plants every three months should not be expected to hinder HLB spread significantly without the aid of other methods of control. Our results show, as expected, that HLB epidemics are strongly dependent on the average number of insects per plant (vector abundance) and rate at which the vectors probe the plants. In fact, the roguing success depends on those two variables. Using parameter values typical of Recôncavo Baiano region, we found results on the verge of invasiveness. Because of that, a combination of roguing, reduction of vector population and reduction of urban vector refuges should stabilize HLB epidemics as long as that combination is used in that region as a whole. On the other hand, if the region fails in adopting those measures pre-emptively, 100% of its plants should be infected in ~10 years after the epidemic onset.

Non-technical summary: We simulated the potential impact of an orange jasmine population on the HLB epidemic in citrus orchards of Recôncavo Baiano region. Our results strongly supports the need of pre-emptive control actions in a fashion of regional management of HLB. The results also show that measures such as roguing or elimination of alternative hosts will not work if used disconnected from other methods.