HLB transmission and disease management

By K.S. Pelz-Stelinski, M.E. Rogers and R.H. Brlansky

Asian citrus psyllid is the vector of the greening or huanglongbing (HLB) associated pathogenic bacterium. To a large degree, current HLB management includes intensive control of the psyllid. HLB management could be improved by understanding the details of how the psyllid transmits the bacterium.

Transmission of the bacteria is a two-step process. First, psyllids must acquire it from infected trees. This is technically called "acquisition." Second, infected psyllids must pass on the bacteria to other trees. This is called "inoculation."

Several studies have been conducted to investigate how psyllids transmit the HLB-associated pathogen. Many previous studies were done using symptom development as the method by which scientists figured out whether the HLB bacterium was transmitted. However, more recently, tools grounded in molecular biology have been developed which allow a much more precise detection and identification of these bacteria. Polymerase chain reaction or PCR is a current tool that is used to accurately detect the presence of bacterium associated with HLB.

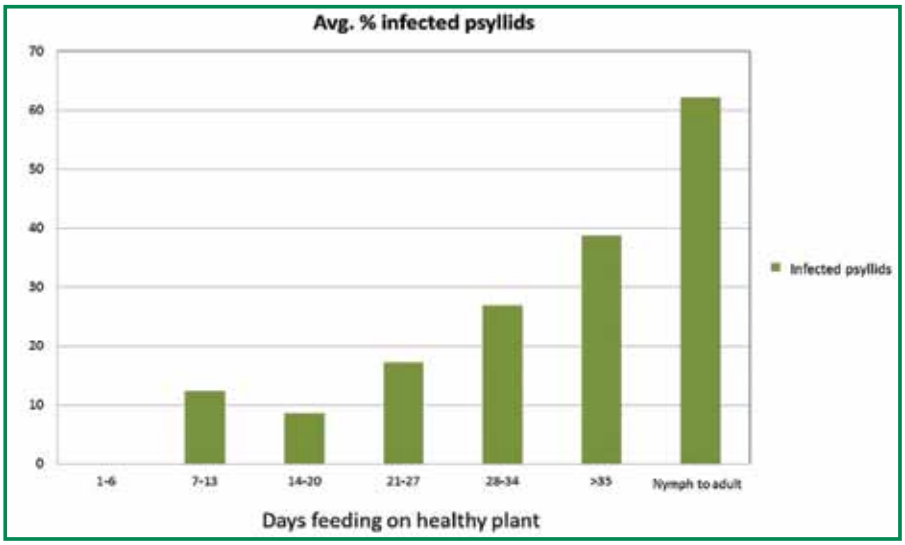

Figure 1. *Percentage of adult psyllids that acquired HLB bacterium after feeding on infected plants. The last bar shows the percentage of adults that acquired the pathogen as nymphs.*

A focus of some recent research has been to determine the specific timing associated with how psyllids acquire and transmit the bacterium associated with HLB in Florida. We examined how long it takes the psyllid to acquire the bacteria from infected trees. This process was investigated in psyllid adults and immature psyllids, called nymphs. We found that the probability psyllids acquire these bacteria from infected plants is much higher if the psyllids hatch from eggs and develop on those infected plants their entire life than if they only feed on infected plants as adults (Figure 1). More than 60 percent of psyllids reared from eggs on infected plants were infected with the bacteria as adults.

Basically, the longer the psyllid is able to feed on the plant, the greater the possibility that it acquires the bacteria. One explanation for this is that the longer psyllids feed on plant sap, the more bacteria they are likely to ingest. In addition, it is possible that over time, bacteria will reproduce in the psyllid. Thus, psyllids that feed longer on plants will harbor more bacteria acquired from plants, and these bacteria may increase in number inside of the psyllid. An earlier study from Japan found that 88 percent of psyllids will acquire the HLB pathogen after one day of feeding. This number is much higher than the rate observed in our experiments with psyllids in Florida, which was 39 percent after 35 days of feeding. This could be due to genetic differences between the psyllid populations.

Previous studies of HLB transmission by psyllids suggest that once a psyllid acquires the pathogen, it will be infected for life. However, in our

work, we have found this is not the case. When we placed HLB-infected psyllids on healthy plants and held them on those plants for an extended period of time, the number of bacteria in those psyllids gradually decreased over time. Thus, it appears that psyllids may need to feed repeatedly on infected plants in order to maintain a high level of the HLB pathogen.

We also have conducted experiments to investigate how long it takes psyllids to inoculate a plant with the HLB-associated bacterium. By placing infected psyllids on healthy plants, we found that one psyllid can infect a plant after only one day of feeding. If a psyllid feeds on a plant more than one day, the probability of a plant becoming infected does not increase. In our studies, an average of 5 percent of the test plants became infected after one psyllid had fed on the plant for at least one day. However, when the number of infected psyllids per plant was increased, the probability that the plants became infected also increased. We found that 70 percent of plants fed upon by 200 infected psyllids developed HLB. Most likely, this is because the number of bacteria inoculated into a plant increases with the number of infected psyllids that feed. Therefore, the likelihood that plants will get infected increases with the number of infected psyllids that feed on the plant.

In addition to acquiring the HLB-associated pathogen from plants while feeding, psyllids can also acquire it from their mother by a process called transovarial transmission. We found that 3.6 percent of psyllids that developed on healthy plants were infected with the pathogen if their mother was also infected. Although the rate of mothers passing the pathogen to their offspring is low, this finding is important because it highlights the importance of preventing egg-laying by psyllids in order to reduce the spread of HLB.

We are continuing our research on pathogen acquisition and inoculation to further understand how acquisition changes in response to temperature and citrus cultivar. Temperature is likely to play a role in these processes, which could result in seasonal differences in the spread of HLB. In addition, we are interested in whether psyllids are more likely to acquire the bacterium from some citrus varieties and whether all citrus varieties are equally likely to develop HLB when infected psyllids feed on them. Differences in the susceptibility of some cultivars to pathogen inoculation may be important when making decisions about replanting.

If there are infected trees in or near a grove, the opportunity for bacterial acquisition and inoculation by psyllids is greater. However, the decision to remove infected trees will depend on how much infection is present in a grove and may not be economically viable. This means that when infected trees are present, psyllid control becomes even more important.

Nymphs that develop on infected trees have the greatest potential to acquire the bacterium. Controlling nymphs can be more difficult than controlling adults. Therefore, pesticide applications timed to control adult psyllid populations before they are able to lay eggs should provide the greatest reduction in bacterial transmission.

As we learn more about the interaction between the psyllid and the HLB-associated bacterium (*Candidatus* Liberibacter asiaticus) and the various types of hosts (citrus and other plants) for the vector and the bacterium, we will be able to better determine those essential times for psyllid control that will help lower the rates of bacterial transmission.

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