How far do psyllids move and when?

Support for large-scale cooperative control

By Lukasz Stelinski

It is now well accepted that Asian citrus psyllids spread the pathogen that causes huanglongbing (HLB) or greening in citrus. By observing HLB progression through citrus groves over time, plant pathologists have made educated guesses about psyllid movement and inferred that psyllids routinely disperse distances of 25 to 50 yards. Based on disease movement between islands in Japan, a maximal dispersal distance of approximately 300 miles has been inferred, and is thought to be mediated by lower jet streams. However, in this case, movement of psyllids by human traffic could have also occurred.

In addition to making inferences based on observing spread of disease, entomologists have also tracked the movement of feral psyllids within and between groves. This was accomplished by marking psyllids in the field with inexpensive and benign proteins and then recapturing them on sticky traps. Psyllids on traps were then analyzed for the proteins, and if found to contain the marker, these psyllids were identified as having moved from "point A to point B." Using this technique, University of Florida researchers initially proved that psyllids could disperse up to 100 yards within three days, and that abandoned citrus groves were a source of infestation for nearby managed citrus groves. Subsequent investigations showed that psyllids were capable of dispersing up to 400 yards within four days, and that a portion (2 percent to 14 percent) of these psyllids moving from abandoned into managed groves carried (and potentially spread) the pathogen that causes HLB.

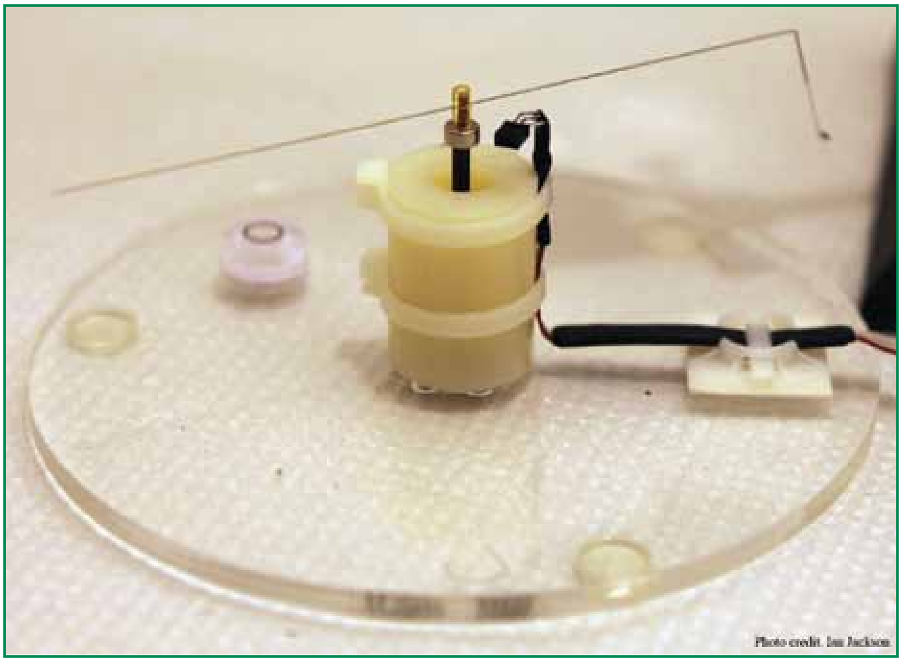

Figure 1. *A laboratory flight mill used to investigate movement of insects, including Asian citrus psyllid.*

Most recently, we have found that psyllids are capable of dispersing a distance of at least 1.25 miles within a period of approximately 12 days. Also, we have found that psyllid movement was not inhibited by potential geographic barriers such as roads and fallow fields. This distance is similar to the maximal distance of dispersal (approximately one mile) reported for the African citrus psyllid, *Trioza erytreae*, using mark-release-recapture experiments.

The flight capabilities of Asian citrus psyllids have also been measured in detail in laboratory experiments with what is called a "flight mill" (Figure 1). The flight mill allows for a tethered psyllid to fly unrestrained around a pivot point. The total flight distance can be calculated from the number of revolutions recorded as well as the speed and duration of the flight. These investigations proved that psyllids are capable of approximately 50 minutes of continuous flight and up to nearly one mile of continuous flight. The laboratory flight mill data are consistent with the long-range flight capability observed by tracking the movement of marked psyllids. Therefore, current evidence indicates that psyllids are capable of moving significant distances driven by their own capability to fly. It is possible that wind-assisted movement can carry them farther, depending on climatic conditions and the elevation they reach.

In addition to figuring out how far psyllids move, several researchers have been interested in finding out if there is a time of year when psyllids move the most. The data collected to date suggest that seasonality of psyllid movement varies from year to year and is tied to the presence of new flush.

A highly regular and repeatable seasonality has not been pinpointed, likely because of the seasonal variation in when spring flushing occurs, which is also offset throughout the state regionally. However, some results suggest that spring is a time when psyllid movement is observed most frequently, particularly as new flush begins to harden off and it's time for psyllids to search out new resources for egg laying and feeding. It's also possible that this psyllid movement is more visible during the spring because populations of psyllid adults are typically greatest during this time of the year. However, recent research conducted by the USDA-ARS (United States Department of Agriculture's Agricultural Research Service) has shown that commercial citrus in Florida can be infested by immigrating psyllids throughout the entire year, and there does not appear to be a time of year when the threat of psyllid infestation due to movement does not exist. Therefore, being vigilant about protecting your grove from outside infestation is a year-long necessity.

Finally, the factors that cause psyllids to move, both biological and environmental, have been or are currently being investigated. To date, wind speed, sunlight and temperature have not been directly correlated with psyllid movement. One of the main driving forces is availability of new flush for adults. This is the most important resource for psyllids since it is the only place on which they successfully develop from the egg stage. Psyllids may use the sun as a reference point for navigation and thus light may influence their settling and movement behavior, but this will require further investigation. The intrinsic biological mechanisms that may trigger psyllid movement and their contribution to psyllid dispersal behavior, such as hunger and mating status, are also currently being investigated. However, it appears that a psyllid that is deprived of its main resource (new flush) is a psyllid that's likely to go on the move.

In summary, the current body of scientific evidence indicates that psyllids are capable of and do move actively for long distances (potentially a mile or more). This movement is due to their flight capabilities, which are quite strong when considering the small size of this insect. Based on disease epidemiology, longer-range dispersals (hundreds of miles) in jet streams have possibly occurred. More movement is clearly visible when there are more adult psyllids present; however, the availability of flush appears to be an important driver of movement rather than other environmental factors.

THE CASE FOR COOPERATIVE CONTROL

The idea that psyllids are bad flyers does not appear to be true. Psyllids may be bad flyers compared with birds; however, a tiny insect smaller than most mosquitos that is capable of one mile of continuous flight is a pretty good flyer compared to a lot of other types of animals. Therefore, the collective body of scientific evidence is consistent with the current strategy of managing psyllids on large and contiguous areas in a cooperative fashion. If there are psyllids within miles of your grove, they are capable of flying to it, and in the process, can likely cross significant distances of non-citrus habitat (examples: fields, lakes, roads). A portion of these psyllids on the move are carrying the bacterium that causes HLB. Therefore, large-scale cooperative psyllid management programs should help prevent migrations of psyllids in search of new flush. This may be one of the reasons why Citrus Health Management Areas in Florida are resulting in significant declines in psyllid populations, as compared with areas where cooperative psyllid management is not taking place.

Abandoned citrus that harbors small and possibly only occasional psyllid populations — and the potential negative impact this causes on commercial production — should also be considered.

Lukasz Stelinski is an assistant professor in the University of Florida's Department of Entomology and Nematology at the Citrus Research and Education Center, Lake Alfred.