

Bindweed Psyllid: Biology, Natural History, and Interactions with the Zebra Chip Pathogen

W. Rodney Cooper^{1*}, David R. Horton¹, Andy Jensen², Nina Barcenas³

¹USDA-Agricultural Research Service, Yakima Agricultural Research Laboratory, Wapato, WA

²Pacific Northwest Research Consortium

³Heritage University, Toppenish, WA

*Address correspondence to Rodney.Cooper@ars.usda.gov

What is the Bindweed Psyllid

The bindweed psyllid, *Bactericera maculipennis*, is native to North America and has occasionally been captured on yellow sticky traps placed within potato fields. This psyllid is similar in size and shape to potato psyllid, *Bactericera cockerelli* (Fig. 1A), but has a painted wing pattern (Fig. 1B) making it readily identifiable. Bindweed psyllids reproduce and develop on a wide-range of plants within the family Convolvulaceae, but the primary host plant for this psyllid in the potato growing regions of the Pacific Northwest is field bindweed, *Convolvulus arvensis*. Field bindweed is an invasive and naturalized weed that is abundant in this region. In fact, the introduction of this weed to the Pacific Northwest may have allowed bindweed psyllid to expand its range into this region. Bindweed psyllid adults are often also captured on matrimony vine (*Lycium* spp.) where they apparently lay eggs, but nymph mortality is exceedingly high on this plant.

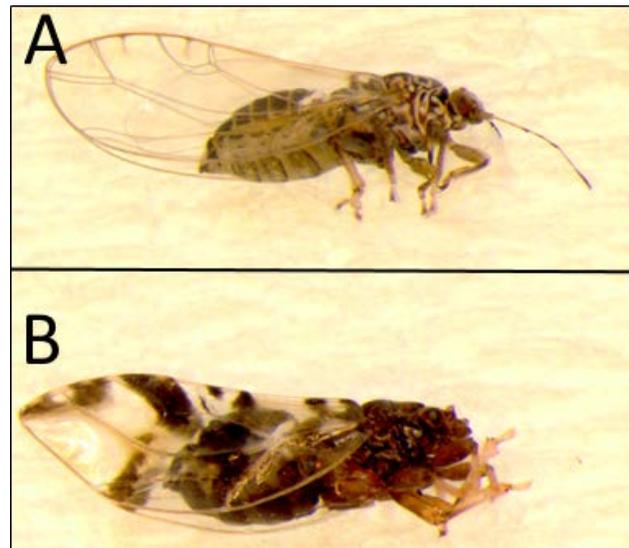


Figure 1. Comparison of potato psyllid (A) and bindweed psyllid (B). Unlike potato psyllid, bindweed psyllid has painted wing patterns.

Interactions between Potato Psyllid and Bindweed Psyllid

Potato psyllid can develop on numerous perennial and annual weeds in the plant families Solanaceae and Convolvulaceae. In fact, the ability for potato psyllid to occur in the Pacific Northwest year-round may be dependent on use of weed hosts (Fig. 2). Although potato crops are available to potato psyllids from roughly May into September, the psyllid likely needs additional hosts to bridge the remaining warm months before potato germination and after potato harvest (Fig. 2). The bridging hosts include, among others, field bindweed and matrimony vine. Although field bindweed is not a preferred host for potato psyllid, both potato psyllids and bindweed psyllids can be collected from field bindweed plants after potato harvest. In addition, adults of both potato psyllid and bindweed psyllid can be collected from matrimony vine year-

round. The shared use of these two host plants - field bindweed and matrimony vine - provides ecological opportunities for the two psyllid species to interact.

Our previous research demonstrated that uninfected potato psyllids can acquire the zebra chip pathogen on bindweed, but only if infected psyllids were present on the plants at the same time (Torres et al. 2015. PLoS One 10: e0142734). This led us to question whether uninfected bindweed psyllids can also acquire the zebra chip pathogen if confined to bindweed plants along with infected potato psyllids.

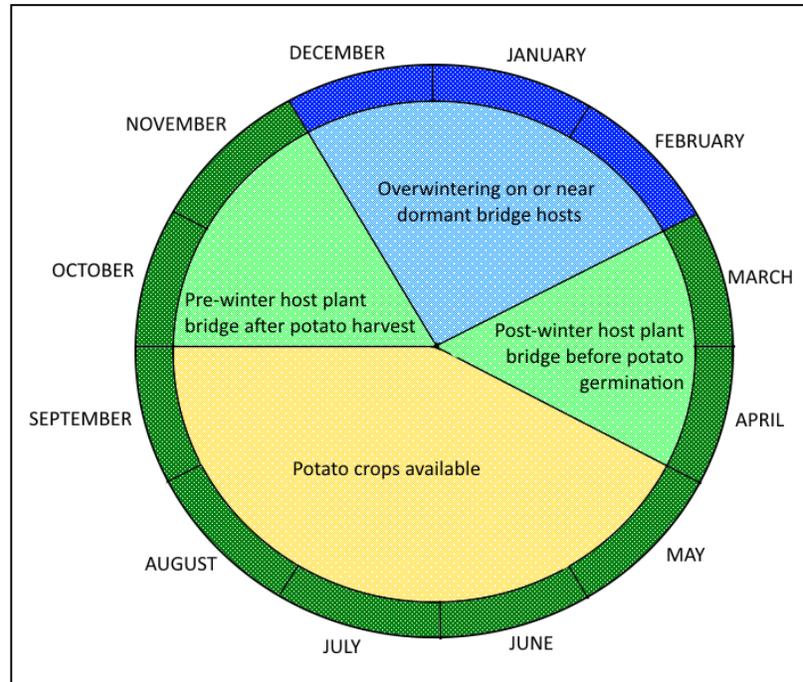


Figure 2. Potato psyllid lifecycle (inside circle) appears to require wild hosts (light green) before potato germination and after potato harvest to 'bridge' warm months between crop availability (yellow) and overwintering (blue). Dark blue roughly corresponds with the coldest months of winter.

Prevalence of the Zebra Chip Pathogen in Wild Bindweed Psyllid Populations

We collected bindweed psyllid adults from seven locations in Washington and Idaho (Figure 3) and screened the psyllids for the presence of the zebra chip pathogen. Infection rates ranged from 7% in Wapato, WA to 60% near Eagle ID (Figure 3). These infection rates were surprisingly high, and surpass those previously observed in wild potato psyllid populations. By analyzing the sequences of three diagnostic gene regions (16S, outer membrane protein gene, and SSR), we determined that the species and strain of the zebra chip pathogen from bindweed psyllid appears to be the same as the one carried by the potato psyllid in the Pacific Northwest.

Plant-Mediated Interspecific Transmission of the Zebra Chip Pathogen

To test whether plant-mediated interspecific transmission of the zebra chip pathogen can occur between bindweed psyllid and potato psyllid, we confined infected bindweed psyllids together with uninfected potato psyllids on bindweed plants. After one week, some of the previously uninfected potato psyllids had acquired the zebra chip pathogen. Consistent with our previous studies, the pathogen was not detected in plants or in uninfected potato psyllids exposed to plants after the infected bindweed psyllids had been removed. Results of our study demonstrate that the zebra chip pathogen can be 'traded' among psyllid species, even on plants that do not readily harbor the pathogen.



Figure 3. Percent of bindweed psyllid adults at each sample location carrying the zebra chip pathogen. Adult psyllids were collected from field bindweed stands at each location.

Can Bindweed Psyllid Transmit the Zebra Chip Pathogen to Potato?

We confined 10 infected bindweed psyllids to each of 15 uninfected potato plants to determine whether bindweed psyllids can infect potato with the zebra chip pathogen. All of the psyllids died within one week indicating that the adults do not feed on potato plants. None of the plants developed visible symptoms associated with zebra chip disease, nor was the pathogen detected in plants using molecular screening methods. Although the bindweed psyllid carries the zebra chip pathogen, this psyllid is fortunately not a direct threat to potato production.

Conclusions

We have found that the bindweed psyllid, which shares weedy hosts with the potato psyllid, is a carrier for the pathogen associated with zebra chip disease. Potato is not a host for bindweed psyllid, so this insect is not a direct pest of cultivated potato despite its ability to carry the pathogen. While we were able to produce transfer of the zebra chip pathogen from infected bindweed psyllid to uninfected potato psyllid, by simultaneously caging both types of psyllids on field bindweed, it is not currently known whether bindweed psyllid populations represent an important source of the pathogen infecting potato psyllid populations under natural field conditions.

10 Years of the Potato Variety Management Institute (PVMI)

Jeanne Debons, Executive Director

Ten years ago the three potato commissions contributed \$225K to establish PVMI. From this a consultant was hired and a feasibility study completed. In 2005 PVMI was officially incorporated as an Idaho 501(c)3 and in July 2006, the company became established in Bend, OR at the home of Jeanne Debons. Early USDA – VAPG grants were achieved for \$250K of matching funds to use for a business plan and early marketing efforts.

PVMI is run by a Board of 9 members who are potato growers and/or potato commission members. Its mission is to *“Promote and administer the new Tri-State potato varieties to maximize their success and return revenues to support the Breeding and Research Program and benefit potato growers of Idaho, Oregon and Washington.”*

There has been a \$2,162,347 contribution to the Universities as of the end of 2015 and an additional Operating Reserve of approximately \$500,000 held by PVMI.

The license revenue as of the end of 2015 is \$518,570 and the royalty revenue is \$3,399,309. The revenue breakdown by region is \$1,239K from Tri-States; \$1,559K from in the U.S. outside the Tri-States and \$1,196K from outside the U.S.

PVMI has established partnerships with more than a dozen foreign countries where Tri-State varieties are being trialed or grown for commercial production. Of these Agrarfrost in Germany is noteworthy as they are a European McDonalds partner who will be conducting large scale trials of several PVMI russets in 2016.