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Biology and Management of Potato Psyllid in Pacific Northwest Potatoes

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Below is a summary of a much longer article posted on the Web at www.potatoes.com.

The potato psyllid is a phloem-feeding insect that has an extensive host range of at least 20 plant families, but reproducing mostly on the potato and nightshade family (Solanaceae). This insect has been very costly to cultivated solanaceous crops in the United States, Mexico, Central America, and more recently in New Zealand. In recent years, a new potato tuber disease, zebra chip (ZC), has caused millions of dollars of losses to the potato industry in the southwestern United States, particularly Texas. However, ZC was for the first time documented in Idaho and the Columbia Basin of Washington and Oregon late in the 2011 growing season. This disease is characterized by development of a dark striped pattern of necrosis in tubers (Fig 1). The pathogen associated with ZC is the bacterium *Candidatus Liberibacter solanacearum* that is vectored by potato psyllid.



Figure 1 ZC tuber symptoms. Photo credit: S.I. Rondon, OSU.

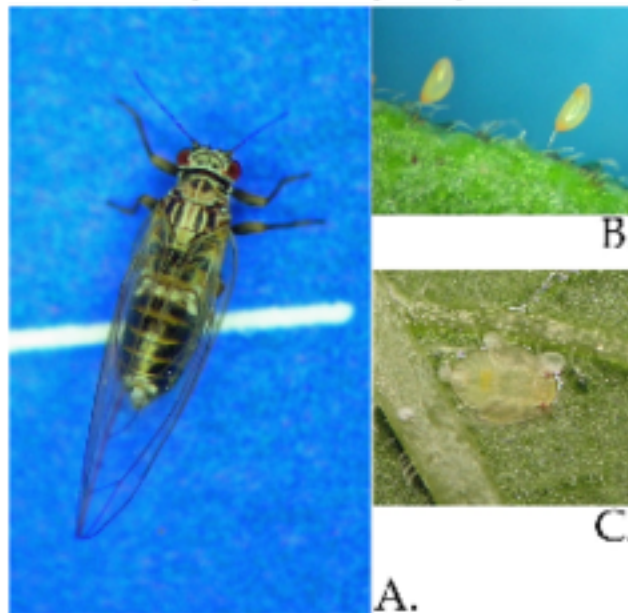
Identification

Potato psyllids pass through three life stages: egg, nymph and adult. All life stages are difficult to detect. The adults look like small cicadas, about 0.08 inch (2 mm) long (Fig. 2A). They are closely related to aphids and leafhoppers and have clear wings that rest roof-like over the body. Although predominantly black, the potato psyllid has white markings.

The first abdominal segment shows a broad white band, the last segment has an inverted white "V". Psyllids jump readily when disturbed.

The football-shaped eggs (Fig. 2B) are extremely small, slightly larger than leaf hairs, and on a short stalk. They are usually on the underside and along the edges of leaves and are usually laid in the upper plant canopy. A 10X hand lens is required to see them.

Psyllid nymphs (Fig. 2C) look like immature soft scale or whiteflies. Unlike whiteflies, when disturbed, they move readily. They are flat and green with a fringe of short spines around the edge. Immature psyllids go through five stages in as little as 13 days in warm temperatures.



Potato psyllid can damage a plant even if it does not carry the pathological bacterium since these insects feed directly on the plant and may weaken it. As they feed, psyllids inject toxins with their saliva that can cause leaf yellowing or purpling, smaller and fewer tubers, and misshapen tubers. This physiological condition has been dubbed "psyllid yellows" disease and is generally less damaging than ZC.

Figure 2. A. Adult potato psyllid, B. Psyllid eggs attached to a leaf edge, C. Immature psyllid.

The insect (adult or nymph) acquires the bacterium when feeding on an infected plant. Once infected the insect is always a carrier of the bacterium. Eggs laid by an adult with the bacterium are also infected. The disease usually takes about 3 weeks from infection to produce symptoms in the foliage and tubers. Plants affected by ZC exhibit a range of symptoms that are similar to potato purple top and psyllid yellows, including stunting, chlorosis, leaf scorching, swollen internodes near apical portions, axillary bud and aerial tuber proliferation, necrosis of vascular system, and early death. The name "zebra chip" refers to the characteristic brown discoloration of the vascular ring and medullary ray tissues within the tubers that is enhanced when tubers are sliced and fried into chips or fries.

Potato psyllids will feed on and transmit the disease-causing organism to all varieties of potatoes. While there are differing susceptibilities across potato varieties, virtually all varieties will express symptoms of ZC.

Potato psyllid has long been known to be present throughout the Pacific Northwest. It has been thought to not overwinter in the PNW, but instead migrate into the area on air currents from the south. The historical lack of ZC in PNW potatoes, even though the insect has long since been present here, is probably due to the insects in previous years not carrying the

pathogen. It is possible that psyllids have carried the disease in previous years in the PNW but disease symptoms were attributed to other causes such as viral infections.

The insect is known to overwinter from California to southern Texas and northern Mexico. Research is underway to confirm whether potato psyllid overwinters in the PNW. Andy Jensen has found potato psyllid adults overwintering in the Boise, Idaho area up until the time of this writing (February, 2012). They were found in *Solanum dulcamara* L. (a.k.a. bittersweet nightshade.) This is a perennial weed native to Eurasia. It can be found in fence rows, pond margins, low woods and roadsides throughout the Pacific Northwest.

Psyllids are typically first detected in PNW potatoes in July, but the timing of the ZC outbreak in 2011 suggests that it first colonized the earliest affected fields in mid June.

Management.

Sampling. Use yellow sticky cards to detect first occurrence of adult psyllids. Place yellow sticky cards such as those used for beet leafhopper in the field, near the edge. We do not have a recommended number of cards per field, but the more cards per field the more likely one will detect psyllids. Spatial and temporal studies indicated that both psyllid abundance and ZC incidence progress over time faster on the edges than in the infields early in the season. As the season progresses psyllids become more evenly distributed throughout the field. Placement of cards outside of fields, such as is recommended for beet leafhopper, is not effective for monitoring potato psyllids.

A second sampling method is to collect ten leaves from ten locations from the first ten outer rows of the field. Collect full sized leaves from the middle of the plant. A hand lens is required to see psyllid eggs and nymphs. Count the number of adults and nymphs, and if you have very good eyesight, eggs. The nymphs reside on the underside of the leaf. Eggs are most commonly present on the leaf's edge. Be aware that adult potato psyllids are active and will fly or jump away when disturbed.

A third method, again originating out of Texas, is use of a sweep net. Take 100 sweeps from around the field perimeter. This method will only collect adults.

Action Threshold. No action threshold exists for psyllids in potato. We suggest that detection of potato psyllids at any level, in any life stage, is the threshold for action until we learn more about how ZC will impact PNW potatoes.

Control. There are no effective non-chemical control tactics for potato psyllids, although research is underway in this area. Fortunately there are a number of insecticides registered on potatoes that have activity against potato psyllids in the adult and/or immature stages. Some insecticides with activity against adults and nymphs will also have activity against the eggs. Season long weekly applications are used in areas (e.g. Texas) where ZC has been problematic. We are not expecting to follow the same lengthy period of control since psyllids are not thought to be in potato fields in the early part of the season.

Resistance Management. If a neonicotinoid (Group 4a) is applied at planting do not apply another Group 4a product later in the season. Do not apply a single mode of action more than twice in a row against potato psyllids or any other insect. For example, do not apply a pyrethroid insecticide more than twice in a row. Do not apply Agri-Mek, Monitor, Provado, Actara or any other product more than twice in a row. For example, do not apply Movento twice and then apply Oberon.

In the PNW, the first life stage detected is usually the adult. Some insecticides have activity against adults, while others do not. In psyllid control programs in other states, when adults are detected, it is recommended that a product with activity against adults be used first. Also, growers may also have other insect pests to control at the same time as psyllids. Following is a table showing the spectrum of activity for insecticides that have activity against potato psyllid. The table shows activity against psyllid life stages and other pests that may be present at the time psyllids are in potato fields.

Growers have two kinds of strategies for controlling potato psyllids in PNW potatoes:

Option 1. Insecticide at planting time followed by foliar applications. Apply a neonicotinoid to the seed piece, in furrow at planting or at cracking, such as Admire Pro, Gaucho, CruiserMaxx, Platinum or Belay. Since potato psyllid is not present at cracking or layby, an application of these products at this growth stage is assumed to be effective. At just prior to the effective decline of the planting time insecticide, initiate a foliar insecticide program. The point at which one decides to make the first application is based on a combination of the pest management professional's aversion to risk and the choice of product. Based on the 2011 field season, if we assumed that the potato psyllid's first arrival to the Columbia Basin was around June 20 based on when first foliage symptoms were observed, the first foliar application should be made prior to that date. For resistance management reasons we recommend that no more than 80% of fields on a farm be treated with Group 4 neonicotinoid insecticides at planting/cracking.

Option 2. Foliar only program. At first detection of potato psyllids, start applying foliar insecticides with known effectiveness against adult potato psyllids. Continue a foliar program until psyllids are no longer present or until your field has been desiccated or harvested.

Timing of Application. Actively growing potato plants can double in size every 7 days until bloom starts. Application of contact (non-systemic) products such as pyrethroid insecticides will only provide control on the plant tissue that is present at the time of application, necessitating a shorter application interval than when using a highly systemic insecticide. Later in the season when a potato plant is not actively growing above ground, a contact insecticide will provide 14 days or longer residual control, often as long or longer than a systemic insecticide. When a potato plant is fully mature, a systemic insecticide can take 2-4 days to become fully translocated throughout the plant.

Table of Activity for Psyllid Life Stages and Other Potato Insect Pests. Each x indicates the insecticide has activity against that pest and life stage.

	Group #	Psyllid Life stage			BLH	CPB	GPA	Thrips	Worms	Mites
		eggs	nymphs	adults						
Monitor	1b		x	x	x		x	x		
pyrethroids	3		x	x	x	x			x	
Platinum	4a		x	x	x	x	x			
Cruiser	4a		x	x	x	x	x			
Belay	4a		x	x	x	x	x			
Admire	4a		x	x	x	x	x			
Venom	4a		x	x	x		x			
Radiant	5		x			x		x	x	
Agri-Mek	6	x	x	x		x		x	x	x
Fulfill	9b		x	x			x			
Beleaf	9c		x	x			x			
Rimon	15	x	x			x			x	
Movento	23	x	x				x	x		x
Oberon	23	x	x							x

Method of Application. In many situations growers choose chemigation, however use of chemigation with non-systemic products may result in substantially reduced insecticide levels on the foliage. Due to our lack of knowledge on effect of method of application on efficacy, do not apply insecticides for potato psyllids in potatoes via chemigation unless you are confident the application will result in adequate deposition of insecticide residues on the foliage. Obtaining adequate coverage, particularly with contact insecticides, is critical since the immature stage of the potato psyllids prefers the underside of the leaves.

For extensive detail on insecticide options and potential use patterns, see the full article posted at

www.potatoes.com/research.cfm.

Storage

- Little information is available on the biology of the disease in storage; however, there is research that shows asymptomatic tubers produced by potato plants infected late in the season may later develop ZC symptoms in storage.
- Experience of ZC researchers suggests that infected tubers do not rot in storage.
- Tubers with symptoms put into storage will maintain those symptoms.

Research

There have been millions of dollars spent on ZC research in Texas and neighboring states. PNW growers stand to benefit from much of this research. The potato commissions of OR, ID, and WA will now be investing in some of those same projects, but also projects specific to our region. Projects of particular importance include:

Overwintering/Migration of the potato psyllid – Does the insect colonize the PNW each year from the south, and if so from where, or does it overwinter here and colonize potatoes from its winter habitats, or is there a combination between overwintering and migration?

Psyllid-specific monitoring tools – Yellow sticky cards are a non-specific and problematic tool for psyllid detection and monitoring. Promising research is underway on discovering and optimizing a sex pheromone-based method of monitoring potato psyllids.

Tuber symptoms post-harvest – Development and progression of symptoms in tubers post-harvest is important and little-studied. Work is underway on this subject using tubers from the 2011 ZC outbreak.

Contacts about ZC and Potato Psyllid

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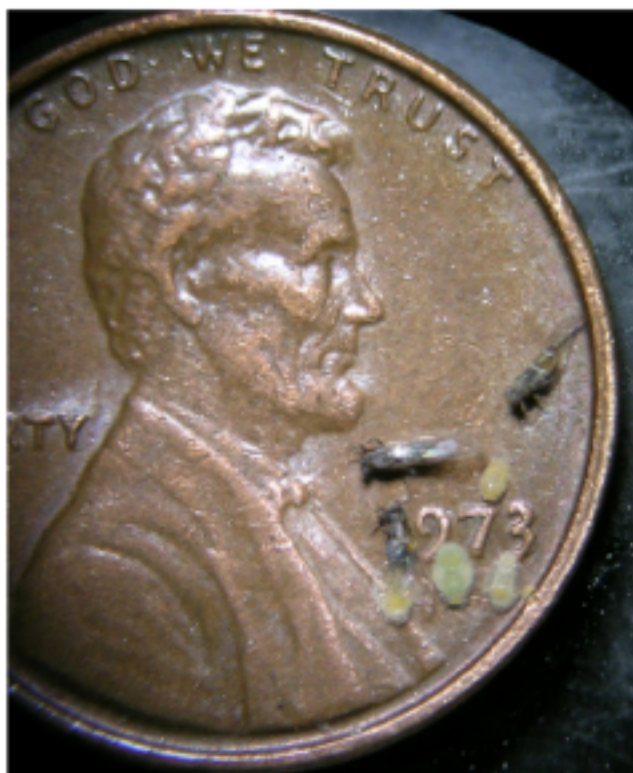


Figure 3. Potato psyllid adults and nymphs on a penny for size reference.