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Aphid Biology – the Basics

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Most crops have at least one associated aphid species that is considered a pest. Aphids can be pests through their direct feeding on the phloem sap of the plant, by transmitting viruses to plants, or by contaminating the harvested product with their honeydew (the common term for aphid poop). Potato is affected by aphids in the first two of these ways. Quite a lot of pest management effort is directed toward aphids on potato. Therefore, as a review for many of you, and to provide a learning resource for people new to aphid biology and their interaction with potato, I thought I would prepare the following primer.

Facts of aphid biology

Aphids have several unusual or unique biological features that are useful for pest managers and crop producers to understand.

- Aphids are all parthenogenetic and viviparous, with telescoping generations and seasonal polyphenism.
 - Parthenogenesis is the reproductive strategy wherein females produce offspring that are genetic copies of themselves without mating with males. All aphids display parthenogenesis, but most also have one generation per year of sexual reproduction (see below).
 - Viviparity is the practice of giving birth to live young. It is in contrast to oviparity, which is the practice of laying eggs. All aphids display at least one generation per year of viviparity, but most also have one generation per year of oviparity (see below).
 - Telescoping generations refers to the fact that aphids are developing young inside them from a very early age. In fact, most aphids are pregnant when they are born! In many species, therefore, a female aphid begins to deposit offspring within a few hours of molting to the adult stage.
 - Seasonal polyphenism refers to aphids' ability to produce multiple types of adults through the course of the season. Most aphids are completely without wings and are known as



Uroleucon sonchi giving birth on sow thistle.

apterous. Almost all aphid species can also produce winged females, known as alate. Remember parthenogenesis? It's interesting to bear in mind that a single female aphid can produce offspring that are genetically identical but are a mix of wingless and winged. Other specialized forms include the viviparous female that hatches from the egg in spring, which is known as the fundatrix; the fundatrix can be similar to others of her species, or have very bizarre morphology and extreme reproductive capacity. Finally, most aphids can produce males and egg-laying females; males can be either winged or wingless depending on the species, and egg-laying females are almost always wingless.

- Aphid species are generally divided into three life cycle strategies known as heteroecious, autoecious, and anholocyclic.
 - Heteroecious aphids are also known as migratory or host-alternating. These species overwinter as eggs on a woody shrub, vine, or tree. Eggs hatch and two or a few generations develop on that host. Then, a generation will form that is mostly or entirely winged, and those females will migrate to completely unrelated species of plants and reproduce on them all growing season. Finally in fall, a special kind of winged female and winged males are produced, which migrate back to the woody host. There, the males mate with egg-laying females. Both common aphids affecting potato in the Northwest are heteroecious: green peach aphid (*Myzus persicae*) and potato aphid (*Macrosiphum euphorbiae*). See pages 4 and 5 for photos of these species' life cycles. Green peach aphid uses peach (and some close *Prunus* relatives) as winter host, while potato aphid uses rose as winter host.
 - Autoecious aphids lack this alternation between unrelated host plants, but otherwise have a similar biology of overwintering eggs, wingless and winged females throughout the growing season, then males and egg-laying females in the fall.
 - Anholocyclic aphids survive completely without sexual reproduction, having only wingless and winged females. Species with this strategy live in warm climates or indoors. Some aphids can be anholocyclic when living in warm places. For example, both green peach aphid and potato aphid can be anholocyclic in places such as the Willamette Valley of Oregon, and even in the Columbia Basin or southwestern Idaho during mild winters.
- Aphids feed on plant sugary sap, which is known as phloem sap (in contrast to the watery sap in the xylem). A few species of aphids feed on non-vascular plants such as mosses. Phloem sap is high in energy but low in nitrogen, a crucial element for production of protein. This means the aphid must process large volumes of sap and excrete the excess sugar in its honeydew.
- Most aphids are very host-specific, able to feed and reproduce on only one or a handful of plant species. The most familiar pest aphids, however, are examples of 'polyphagous' feeding biology, that is, they are capable of developing on many plant species. Both potato aphid and green peach aphid are examples of polyphagy, and can accept hundreds of plant species as hosts.
- There are just over 5,000 species of aphids 'known to science' around the world. In the western U.S. there are over 500 species. The exact number is not known because new species are constantly being discovered and described, plus species are accidentally introduced to the U.S. every year.



A *Nearctaphis* fall migrant on mountain ash with her newborn young.

- Some favorite host plants for green peach aphid and potato aphid are also common weeds in potato production (e.g. nightshades, lamb's quarters, pigweeds, tumble mustards and other weedy mustards, stork's bill) or crop plants (e.g. canola and other cole crops, tomato, pepper). Both species are known to develop on grains like corn or wheat, or legumes like beans, peas, or alfalfa, but do so only **very rarely**.

Other resources

Given that entire books have been written about aphids, interested readers can find much more information online at sites such as:

- Aphids on the World's Plants, <http://www.aphidsonworldsplants.info/>, by Roger Blackman and Victor Eastop.
- Aphid Travels and Research, <http://aphidtrek.org/>, by Andy Jensen.
- The aphid pages on Influential Points, http://influentialpoints.com/Gallery/Aphid_genera.htm, by Bob Dransfield and Bob Brightwell.

or in books such as:

- Blackman, R.L. 1974. *Aphids*. Ginn & Company, London, 175 pp.
- Dixon, A.F.G. 1998. *Aphid Ecology, An optimization approach*, 2nd edition. Springer Science & Business Media, New York. 300 pp.
- Minks, A.K. and P. Harrewijn, eds. *Aphids, Their Biology, Natural Enemies, and Control*, vols. A (1987), B (1988), and C (1989). Elsevier, New York.



Winged female of the rose aphid, so common in gardens (*Macrosiphum rosae*).

Spring



Fundatrix on rose

Summer



Wingless & winged females, many hosts

Fall



Egg-laying females, males

Potato aphid life cycle

*Macrosiphum
euphorbiae*



Spring

Summer

Fall



Spring generations on peach



Wingless & winged females,
many hosts



Egg-laying females, males
(not shown) on peach

Green peach aphid life cycle

Myzus persicae

