University of Idaho Extension

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Sugar beet root aphids: identification, biology, & management

by Erik J. Wenninger

The sugar beet root aphid[1] is a pest of sugar beets that occurs throughout the major sugar beet-growing regions of North America. As the common name suggests, sugar beet root aphids feed on the roots of sugar beet plants. Infestations may be sporadic, but in severe cases may reduce tonnage and sucrose levels by more than 30 percent and may reduce recoverable sucrose per acre by more than 50 percent.

Aphids in this group have complex life cycles and typically use cottonwood or poplar trees (in the genus *Populus*) as their primary hosts and annual or biennial plants as their secondary hosts. Over the summer, sugar beet root aphids produce several generations on beets and other secondary hosts; some individuals overwinter in the soil within beet fields whereas others return to *Populus* trees during late summer to fall.

Few insecticides are registered against sugar beet root aphids, and no insecticides are available for rescue treatments; therefore, management of this pest in sugar beets relies primarily on the use of resistant varieties and cultural control practices.

This publication will help you design an integrated pest management (IPM) program for management of the sugar beet root aphid. The IPM approach combines cultural and biological controls with field scouting in order to reduce the need for chemical controls. Beet growers who use IPM can increase profits while encouraging natural enemies of pests and reducing potential harmful environmental effects associated with pesticides.

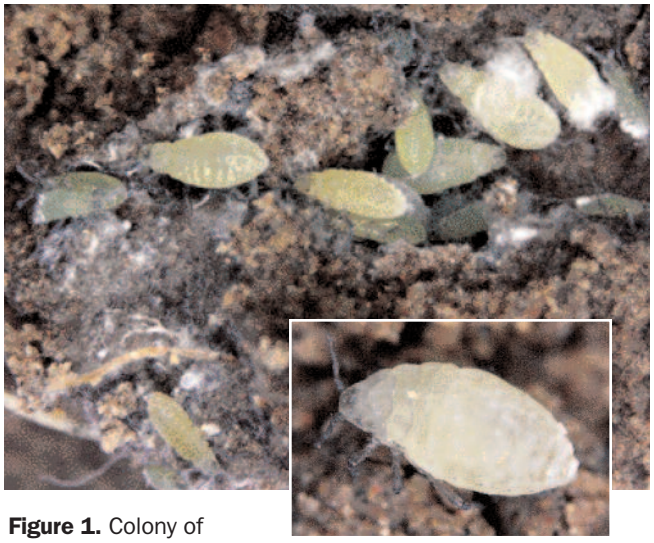

Figure 1. Colony of sugar beet root aphids. Individuals vary in size depending on developmental stage, but are typically pale whitish yellow and broadly oval to pear shaped. **Inset**. Mature wingless female, produces nymphs during the summer and may overwinter in the soil within beet fields.
Photos by Erik J. Wenninger, University of Idaho

[1]The species name of the sugar beet root aphid has been variously stated as *Pemphigus betae* and *Pemphigus populivenae*. Recent evidence suggests that root aphids attacking sugar beets represent a complex of species that may include *P. betae, P. populivenae*, and possibly other species; the distributions of these species and whether other species are part of the complex remain to be fully investigated. For the purposes of this publication, it is assumed that—if represented by multiple species—the biologies of the root aphid species attacking sugar beets are similar enough to be considered as a species complex.

PEST DESCRIPTION

Sugar beet root aphids develop through three life stages: egg, nymph, and adult. Under certain environmental conditions or at different times of the year, adults may be winged or wingless and the egg stage may or may not be found. During most of the summer, when root aphids are infesting sugar beets, only wingless, asexually reproducing females are found. These females may produce up to seven generations over the summer, with each generation of females giving birth to "live" young (i.e., eggs hatch within the mother, which then gives birth to nymphs rather than laying eggs).

Sugar beet root aphids may be pinhead sized and up to 5/64-inch (2 mm) long. Aphids found on roots are pale whitish yellow and broadly oval to pear shaped (Figure 1). They secrete white, waxy strands, which give beets a distinctive "moldy" appearance (Figure 2) that makes infestations more noticeable. These waxy, "mold-like" secretions are not likely to be confused with symptoms associated with the most common sugar beet diseases.

Figure 2. Characteristic "moldy" appearance of a sugar beet root results from white waxy secretions produced by a colony of sugar beet root aphids.
Photo by Erik J. Wenninger, University of Idaho

LIFE CYCLE

Sugar beet root aphids have a complex life cycle that may include the seasonal use of vastly different host species and separate phases of sexual and asexual reproduction (Figure 3).

The primary host plants of sugar beet root aphids are certain deciduous trees in the genus *Populus*, including narrowleaf cottonwood, balsam poplar, and black cottonwood. These trees do not occur in unirrigated plains and desert areas where sugar beets may be grown, but can be found near water courses and at higher elevations near many sugar beet- growing areas.

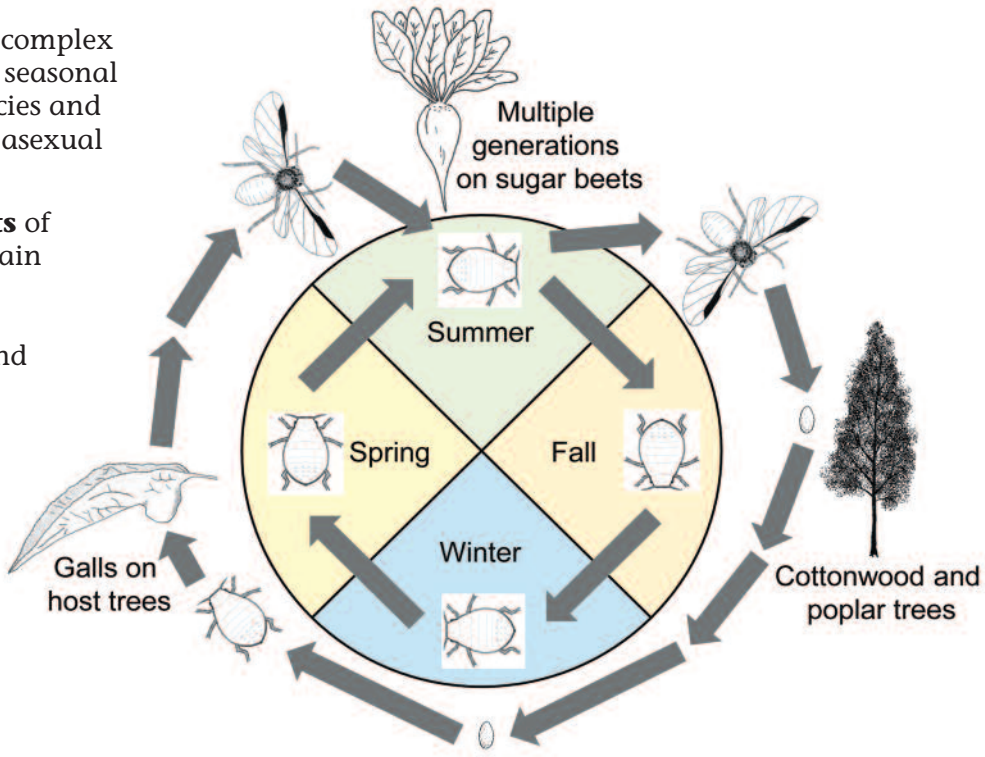

Figure 3. Generalized life cycle of the sugar beet root aphid. A portion of the population overwinters as wingless adults in the soil in sugar beet fields and can colonize nearby fields during the spring; other individuals develop into winged adults that lay overwintering eggs on *Populus* trees. Aphids that hatch from these eggs during the spring produce galls on tree leaves; ultimately, winged migrants emerge from galls to infest sugar beets in mid to late summer. *Drawings by Erik J. Wenninger, University of Idaho*

During late summer to early fall, winged females develop and fly to the primary hosts where they go through one sexual generation. Each female lays a single overwintering egg within bark crevices of a host tree.

During the spring, overwintered eggs hatch, and the female nymphs that emerge move to developing buds on the host tree. Feeding by a nymph induces the formation of a pouch-shaped gall (or abnormal swelling) on the midrib of the leaf (Figure 4), which may project from the upper or lower side of the leaf. Within each gall, a female asexually reproduces offspring that develop into winged adult females.

Early to mid-summer. These winged adults disperse to their secondary host plants during early to mid-summer. Females may migrate long distances, assisted by wind dispersal, before establishing colonies on sugar beets and other secondary hosts. Up to seven generations of wingless female aphids may be produced over the summer on secondary hosts before winged adults develop and return to the primary host trees.

Winter. A portion of the population overwinters not by dispersing to *Populus* trees, but by remaining in the soil of sugar beet fields as wingless adults; aphids that overwinter within beet fields may be associated with the roots of herbaceous weeds. It is thought that overwintering of root aphids in the soil is important in beet growing areas that are isolated from *Populus* trees; however, this aspect of the biology of root aphids is still poorly understood. Aphids that overwinter in sugar beet fields should be able to infest the following year's sugar beets earlier in the season than aphids that disperse from *Populus* trees; however, because aphids that overwinter in sugar beet fields are wingless, they cannot disperse very far.

DAMAGE AND HOST PLANTS

Like all aphids, sugar beet root aphids have piercing/sucking mouthparts that are used to feed on plant fluids. Sugar beet root aphids feed on the roots of their host plants and do not feed on the foliage of sugar beets as do green peach aphids and black bean aphids. Root aphids cause damage to sugar beets by sucking sap from plant roots, which interferes with water and nutrient uptake by the plant.

Figure 4. Feeding by a sugar beet root aphid nymph induces the formation of a pouch-shaped gall (or abnormal swelling) along the midrib of the leaf of certain *Populus* tree hosts. Galls may project from the upper or lower surface of the leaf, and multiple galls may be found on a single leaf.
Photo by K. Floate, Agriculture and Agri-Food Canada

Root aphids feed primarily on the secondary roots, but when numerous, they can be found on the tap root as well. Mild infestations may go unnoticed without inspection of the roots, but severe infestations may cause aboveground symptoms, including wilting and yellowing of the leaves. Aboveground symptoms and damage to sugar beets are exacerbated by drought stress. Infestations may spread by movement of wingless aphids from an infested plant to adjacent plants, creating elliptically shaped damage patterns in fields (due to the closer proximity of beets within versus between rows). Even in the absence of aboveground symptoms, considerable losses of yield may occur. Severe infestations of sugar beet root aphids may reduce both tonnage and percent sucrose by more than 30 percent, raise brei nitrate levels, and reduce recoverable sucrose per acre by more than 50 percent.

Primary host plants: *Populus* trees

Sugar beet root aphids form pouch-shaped galls (Figure 4) on the leaf blades of trees in the genus *Populus*, including: narrowleaf cottonwood (*Populus angustifolia*), balsam poplar (*P. balsamifera*), and black cottonwood (*P. trichocarpa*). Hybrid crosses including those involving narrowleaf cottonwood and eastern cottonwood (*P. deltoides*) or Fremont cottonwood (*P. fremontii*) may also produce suitable host trees.

Secondary host plants: sugar beets and weeds

In addition to using sugar beets (*Beta vulgaris*) as secondary hosts, sugar beet root aphids also feed on several cultivated relatives of sugar beets (e.g., table beets and Swiss chard) and spinach (*Spinacia oleracea*). Sugar beet root aphids also have been found on alfalfa (*Medicago sativa*), but this is probably a poor host, and root aphids are not considered to be pests of alfalfa.

Important secondary hosts of sugar beet root aphids include the weeds common lambsquarters (*Chenopodium album*; Figure 5) and pigweed (*Amaranthus* spp.). Management of these weeds is important to the overall management strategy for sugar beet root aphids (see IPM section). Several other plants—including other important weeds found in and around sugar beet fields—have been reported as secondary hosts of root aphids, but the host status of these plants has yet to be confirmed. These possible secondary hosts include green foxtail (*Setaria viridis*), prostrate knotweed (*Polygonum aviculare*), and dock (*Rumex* spp.). Other root aphid species may be found on alternate weed hosts that are also used by sugar beet root aphids (Figure 6), but these other species are not known to attack sugar beets; these other root aphids may be tentatively distinguished from sugar beet root aphids by different body color and/or the lack of obvious waxy secretions.

Figure 5. Sugar beet root aphid infestation on the weed common lambsquarters. Note the white aphid secretions on the roots (circled). Inspection of roots from common lambsquarters and other weed hosts of sugar beet root aphids is a convenient and non-destructive method of preliminary scouting for root aphids in and around beet fields. *Photo by Erik J. Wenninger, University of Idaho*

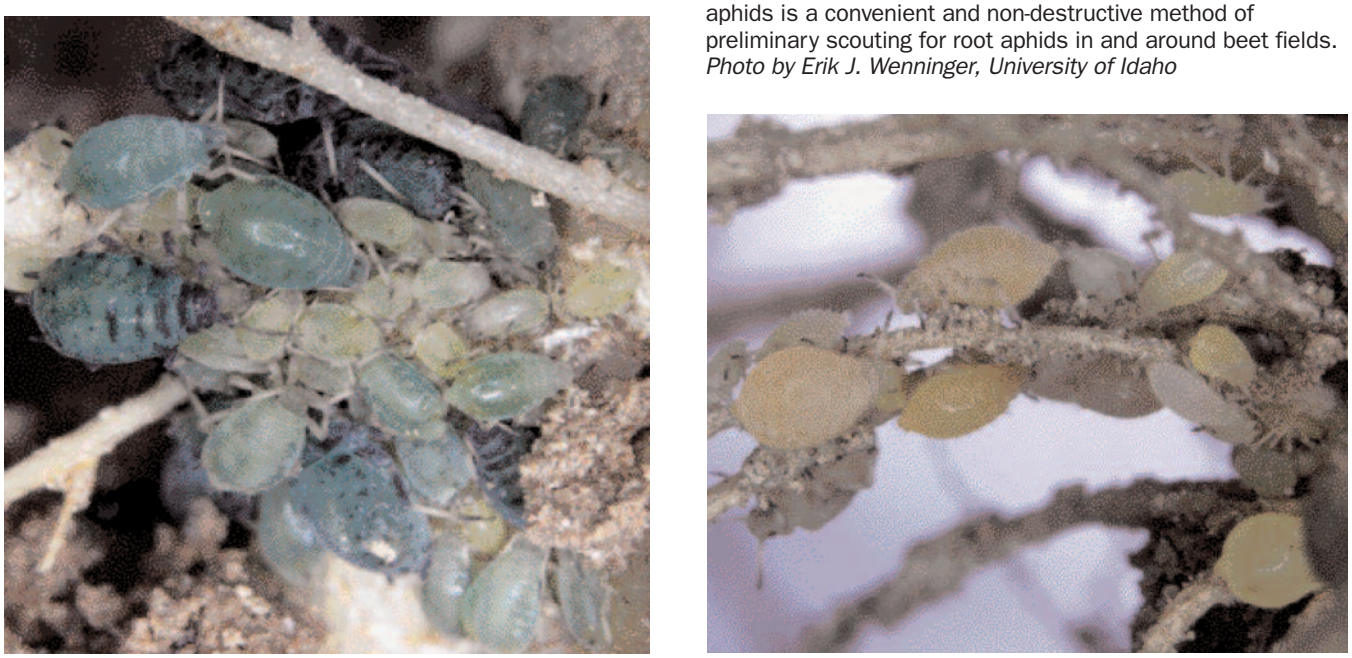

Figure 6. Two unidentified species of root aphids found on the weed common lambsquarters. These aphids can be distinguished tentatively from sugar beet root aphids by a darker green coloration and/or lack of obvious white, waxy secretions. These species are not known to attack sugar beets. *Photos by Erik J. Wenninger, University of Idaho*

INTEGRATED PEST MANAGEMENT (IPM)

Host-plant resistance

The use of resistant sugar beet varieties is the most effective management tool for root aphids. Seed companies should have the most current information on the resistant varieties available. Among varieties that are not specifically marketed as being resistant to root aphids, there is some variability in regard to relative tolerance to root aphid infestations. Not all varieties have been screened for resistance or tolerance to root aphids, so if personal experience shows that a given variety supports high aphid populations and has reduced sugar yield, consider avoiding that variety in the future. Within a resistant variety, some individual variation among plants may be observed in regard to degree of resistance.

Cultural control

In combination with using resistant varieties, the use of cultural control tactics is a cornerstone of successful management of sugar beet root aphids. Several cultural methods should be used in combination to reduce the number of aphids colonizing fields or limit susceptibility of plants to damage from aphids. Cultural control tactics to combat root aphids include: proper irrigation, crop rotation, weed control, and sanitation.

Proper irrigation—Sugar beet root aphid infestations and damage to sugar beets are exacerbated by drought stress. Maintaining a proper irrigation schedule—especially during late summer when aphid populations in beets are at their highest levels—enhances the crop's ability to resist attack from aphids.

Crop rotation—If possible, avoid planting new sugar beet fields directly adjacent to the previous year's field if that field was infested with root aphids. Any aphids that overwintered in the previous year's field may migrate to the adjacent field. Although dispersal by these wingless individuals is limited, it also occurs earlier in the season than migration of winged aphids, creating greater potential for damage to young plants—albeit in a relatively restricted area of the field. Short rotations of sugar beets (fewer than three years) may also favor root aphids, especially if alternate weed hosts persist in the interim crops.

Weed control—Potential for damage to sugar beets from root aphids is reduced by good management of weeds that can serve as alternate secondary host plants of root aphids (including lambsquarters, pigweed, and possibly green foxtail, prostrate knotweed, and dock). Root aphids that overwinter within harvested sugar beet fields may continue feeding and reproducing on these weeds during the following seasons if the weeds are allowed to persist in subsequent crops.

Sanitation—Equipment, including harvesting and tilling implements, used on infested fields should be cleaned before use on uninfested fields to limit spread of root aphids. Similarly, because aphids can be transported in irrigation water, tail water from infested fields that are surface-irrigated should not be used on other fields.

Biological control

A small black and yellow fly (*Thaumatomyia glabra*; Figure 7) that—in its larval stage—feeds on sugar beet root aphids is capable of reducing root aphid infestations below damaging levels.

A fungus (*Entomophthora aphidis*) also has been reported to drastically reduce root aphid populations in some years. Other arthropod natural enemies, including predatory ground beetles, likely contribute to control of root aphids to some extent. We do not yet know enough about *T. glabra* or other natural enemies to suggest practical ways of manipulating and enhancing

Figure 7. Adult *Thaumatomyia glabra* are about 5/64–1/8" (2–3 mm) long, and may be found alighting on foliage of sugar beets. The larval stage of this fly feeds on sugar beet root aphids and is capable of reducing aphid infestations below damaging levels.
Photo by Erik J. Wenninger, University of Idaho

their effects other than avoiding any unnecessary insecticide applications.

Currently, no commercial biocontrols are available.

Chemical control

Few insecticides are registered against the sugar beet root aphid, and field trials suggest that these products provide, at best, only suppression of root aphid populations.

The following commercial seed treatment products registered in Idaho may provide limited protection against sugar beet root aphids because the active ingredient is present only at low levels by mid to late summer when aphids typically infest sugar beets. These seed treatment insecticides can be applied only by commercial seed treaters.

- Thiamethoxam (Cruiser 5FS)
- Imidacloprid (Agrisolutions Nitro Shield, Agristar Macho 600 ST, Attendant 480 FS, Axcess Insecticide Seed Treatment, Dyna-Shield Imidacloprid 5, Gaucho 480 Flowable, Gaucho 600 Flowable, Imida E-AG 5 F ST, and Senator 600FS)

The only other insecticide currently registered against root aphids in Idaho is terbufos (various formulations of Counter). However, field trials using terbufos in Minnesota showed little or no efficacy against root aphids. Several foliar insecticides (none of which is currently registered in Idaho against root aphids) tested in field trials have been found to be ineffective and in some cases actually increase root aphid populations—perhaps because these insecticides kill *T. glabra* and other natural enemies of root aphids.

For current information on registered insecticides, consult the *Pacific Northwest Insect Management Handbook* (http://uspest.org/pnw/insects).

Scouting and thresholds

Most sugar beet fields may be scouted for root aphids beginning in mid to late summer; however, beets planted adjacent to any fields that were infested with root aphids the previous year should be scouted at the beginning of the season. Similarly, beets planted in a field with a history of root aphid infestation—especially if weed control has been poor in the intervening years—should be scouted at the beginning of the season.

Within fields that are planned for sugar beets the following year, late-summer scouting for root aphids on weed hosts can aid in preparing for and mitigating possible infestations on the beet crop next year.

Any sugar beets exhibiting aboveground symptoms (wilting and/or yellowing of the leaves) should be dug up to inspect the roots for aphids and their white, waxy secretions. Pulling alternate weed hosts found within or adjacent to sugar beet fields and inspecting the roots for aphids may be another convenient and non-destructive method of preliminary scouting.

If aphids are found on the roots of weeds, sugar beet roots also need to be inspected before crop infestation can be confirmed. Root aphid infestations may be most evident when populations are highest (during August or September). When root aphid infestations are found, the cultural control methods described on page 5 should be followed to mitigate damage potential, and the use of resistant sugar beet varieties may be considered for future plantings. Note that beets grown in soils that are high in silt or clay and/or low in sand are more conducive to cracking, which may facilitate establishment and spread of root aphids.

No formal economic thresholds exist for making insecticide treatment decisions against the sugar beet root aphid, and—as stated above—insecticides registered against root aphids provide only moderate control at best. Moreover, because the only registered insecticides are seed treatments and terbufos (which has a pre-harvest interval of 110 days), decisions on insecticide treatment would have to be made before infestations could be assessed.

About the author—**Erik J. Wenninger** is a research and extension entomologist with the University of Idaho College of Agricultural and Life Sciences Department of Plant, Soils, and Entomological Sciences. He works out of the University of Idaho Kimberly Research & Extension Center. Contact him at erikw@uidaho.edu.

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Trade Names—To simplify information, trade names have been used. No endorsement of named products is intended nor is criticism implied of similar products not mentioned.

Groundwater—To protect groundwater, when there is a choice of pesticides, the applicator should use the product least likely to leach.

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