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Aphids on Cruciferous Crops

Identification and Management

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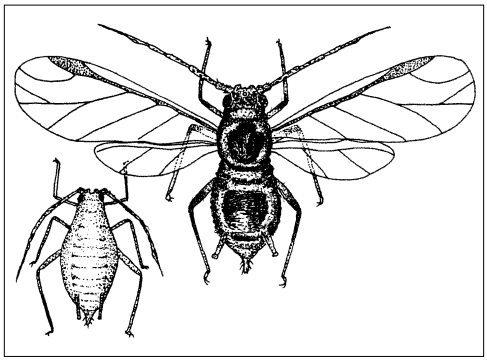
Cruciferous crops (including cabbage, collards, cauliflower, broccoli and kale) are produced throughout much of Texas, with most commercial production in the Lower Rio Grande Valley and Winter Garden areas. At least five species of aphids are of economic importance to these crops, including the turnip aphid, *Lipaphis erysimi* (Kaltenbach); green peach aphid, *Myzus persicae* (Sulzer); poplar petiole gall aphid or cabbage root aphid, *Pemphigus populitransversus* Riley; cabbage aphid, *Brevicoryne brassicae* (Linnaeus); and cotton aphid, *Aphis gossypii* Glover. The turnip aphid, green peach aphid and poplar petiole gall aphid have generally been the most damaging in Texas.

To properly manage aphid pests, you must know the species with which you are dealing. This publication will help you identify and manage aphids commonly found on cruciferous crops.

General morphology



Aphids are small, pear-shaped, delicate insects with soft, fragile bodies. Adults range from 1.5 to 2.5 mm long, depending on the species. Adult aphids may be winged (Fig. 1A) or wingless (Fig. 1B). Immature aphids, called nymphs, look much like adults but are smaller and wingless. Nymphs that will develop into winged adults have external wing buds. Aphids may be light green, yellow, pink, purple, black or mixed colors. There can be considerable color variation even within a small colony of a single species. Some aphids are covered with waxy secretions.

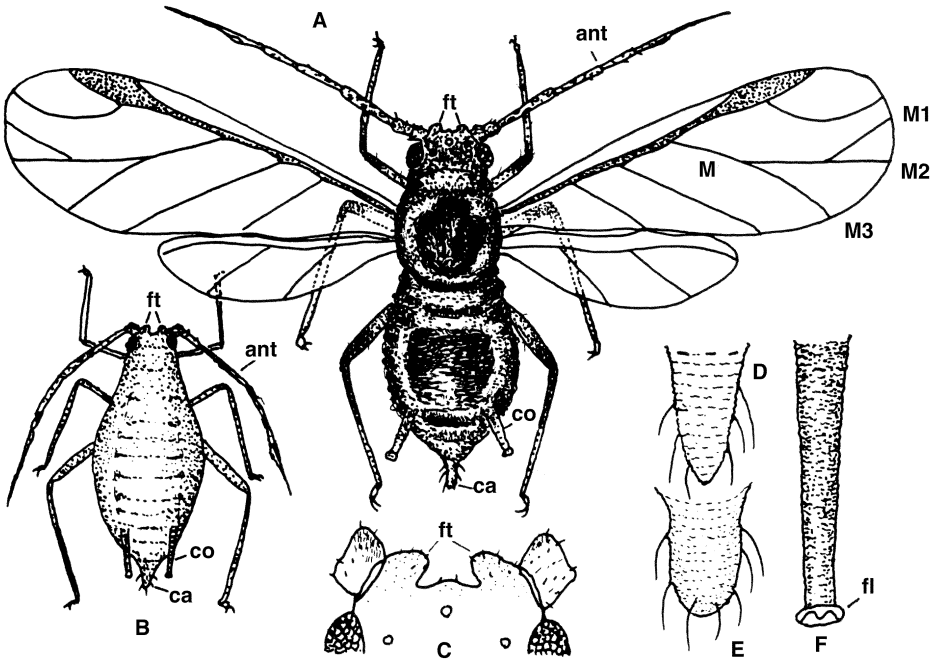


Figure 1. General aphid morphology.
A—adult winged aphid
B—adult wingless aphid
C—frontal tubercles (ft) at base of antennae
D, E—cauda
F—cornicle

ant=antennae, ca=cauda, co=cornicle, fl=flange, ft=frontal tubercle, M=median wing vein

Key morphological characteristics of aphids used in identifying aphid species are shown in Figure 1. The five characters used in the keys (pages 7 and 8) include the length and segmentation of the antennae (Fig 1. ant), the branching of the median vein of the front wing (Fig. 1 M, M1, M2 ,M3), and the size and shape of the frontal tubercles (Fig.1 ft), cornicles (Fig. 1 co), and cauda (Fig. 1 ca).

The frontal tubercles are small, bump-like projections at the base of the antennae. The presence or absence of the frontal tubercles, and their shape, are used in identification. The cornicles are a pair of tailpipe-like tubes projecting upward and backward from the upper, rear surface of the aphid. Their length, thickness, shape and color are key characteristics. The cauda is the structure at the rear end of the body. The shape of the cauda and the appearance of the hairs on the cauda are used in aphid identification.

Life cycles

Figure 2. Aphid giving birth to live young.

Aphids have complex and varied life cycles. Aphid colonies on cruciferous crops consist mainly of wingless females and nymphs during most of the growing season. Winged females are far less common.

An aphid colony normally starts with a winged female that immigrates from another plant or field. Winged females infest a crop and give birth to living young that can produce their own offspring without mating. This asexual reproduction produces only female offspring. Each female produces about 50 to 100 nymphs, depending on the species. The entire life cycle can be completed within a few weeks, or it may require up to 2 months, depending on the temperature.

The actual development rate, reproductive rate and adult longevity are greatly affected by temperature and host plant. Because of this flexibility, a population can increase very rapidly when conditions are favorable. Winged migrants develop whenever a change of host is required or when living conditions become unfavorable because of overcrowding, host deterioration, or temperature extremes.

Some species require a change of host during the year. The poplar petiole gall aphid, for example, generally uses poplar trees as a summer host and crucifers as a winter host.

Figure 3. Poplar petiole gall aphids reproduce in galls in poplar trees during the summer.

Damage

Aphids damage cruciferous crops both directly and indirectly. The feeding of adults and nymphs harms plants directly, while indirect damage can result from the secretion of honeydew, the transmission of plant diseases, and the contamination of the harvested crop.

Aphids have piercing-sucking mouthparts. They insert their needle-like mouthparts in plant tissues and remove plant juices, thus robbing the plant of nutrients. Leaves infested with aphids become curled or twisted, and when aphid populations are large, entire plants become wilted, distorted or yellowish. Small plants can be killed or severely stunted. Infested plants may produce small, unmarketable heads or foliage. Plant distortion also compounds control problems because aphids are somewhat protected from contact insecticides inside the curled leaves.

Figure 4. Cabbage stunted by aphids.

As aphids feed they excrete a sweet, sticky substance, known as honeydew, from their cornicles. Honeydew, which has a very high sugar content, supports the growth of a black, sooty mold fungus. With low pest density, honeydew and sooty mold merely contaminate the crop and reduce its marketability. With heavy pest pressure, sooty mold can become thick enough to block sunlight, which reduces photosynthesis and affects yield.

Aphids may introduce disease organisms as they feed. Sometimes the transmission of disease is incidental—the disease organism simply hitches a ride on the aphid. Other disease organisms use aphids as an important part of the disease cycle. That is, the disease goes through a reproductive cycle inside the aphid before it is transmitted to plants. This is the case with many viral diseases. Although the transmission of diseases is of primary concern with aphids in many crops, and the aphids discussed in this publication are known to transmit many plant viruses, viral diseases on cruciferous vegetables in Texas generally are of minimal concern.

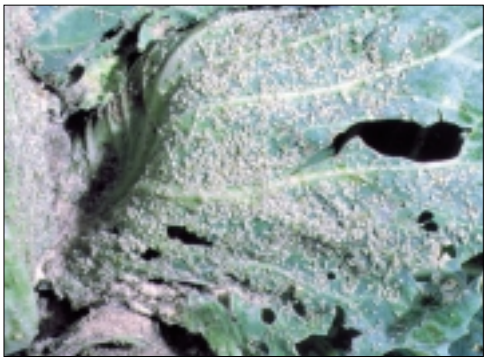


Figure 5. Cabbage infested with aphids.

Aphids can have an economic effect on a crop at population levels well below densities that would reduce yield. The mere presence of aphids and their by-products contaminates

the crop and affects marketability. This is particularly true of crops destined for processing. Because of strict tolerances for insect contamination, plants often must be treated near harvest time to prevent contamination by aphids, honeydew and sooty mold. Occasionally, even fields in which aphids have been controlled by natural enemies must be treated with insecticides to remove aphid predators, which also contaminate the harvest.

Figure 6. Destroy crop residue to decrease pest carryover to the next crop.

Aphid management

Cultural Control

Cultural practices can be helpful in preventing aphid infestations or reducing their severity. Crops should be produced in a manner that encourages rapid, vigorous growth. Avoid planting near aphid-infested crops or land from which such a crop has been recently removed. A far too common practice that should be avoided is side-by-side sequential plantings of the same or related crops. Although sequential planting extends harvesting, it also may lead to the buildup of many pest populations, including aphids. Alternate host plants in the vicinity of the crop should be destroyed before planting. When possible, time planting so that the crop escapes the environmental conditions most favorable to aphid development. Finally, immediately after a crop is harvested, destroy the crop residue and culls that may help aphids carry over to the next crop or produce aphids that infest nearby crops.

Heavy rain, especially when accompanied by strong winds, can significantly reduce aphid populations by washing the aphids off the plants. Crops grown under sprinkler irrigation may also have less problem with aphids.

Figure 7. Convergent lady beetle adult.

Natural Enemies and Natural Control

Aphids have many natural enemies, including many species of predators, parasitoids and pathogens. When aphid populations are small, parasites and predators can frequently eliminate them. Diseases also can eliminate aphid populations, but tend to have their greatest impact only after the aphid population has greatly exceeded an acceptable level. Even under moderate pest pressure natural enemies can frequently eliminate aphids if given enough time. Whether growers can allow the time for natural enemies to work is influenced by the stage of the crop and the urgency of control. The level of beneficial insect activity and speed with which control is needed are important factors in making decisions about treatment.

Figure 8. Green lacewing adult and larva.

The most common predators of aphids are adult and larval lady beetles, green lacewing larvae, and syrphid fly larvae. Lady beetle adults and larvae eat as many as 200 aphids per day and as many as 2,400 in their lifespan. Among the most common lady beetles in Texas are the convergent lady beetle,

Hippodamia convergens; the pink spotted lady beetle, *Coleomegilla maculata*; and several species of *Scymnus* lady beetles. Larvae of green lacewings are also efficient predators, consuming as many as 100 aphids per day.

Many species of parasitic wasps help regulate aphid populations in vegetables. Two of the most common are *Lysiphlebus testaceipes* and *Diaeretiella rapae*. The adult wasps are tiny and seldom seen, but their presence is readily observed. Aphids that have been parasitized swell up until they are almost spherical in shape, then turn a brassy brown. These swollen, hardened aphids are called mummies. The parasitoid develops inside the aphid, then chews a circular hole in the abdomen of the aphid mummy and emerges. Parasitism can increase rapidly in an aphid population, often from about 10 percent to more than 90 percent in about a week. Unfortunately, this often occurs too late to be of commercial benefit, and aphid mummies are a crop contaminant.

Aphids are susceptible to fungal diseases when it is warm and humid. Entire colonies of aphids can be killed when conditions are right. Unfortunately, most of these diseases spread most readily and have their greatest effect only after aphids have reached high densities. To determine whether there is disease in an aphid population, look for dead aphids that have turned reddish or brown and have a fuzzy or shriveled texture. Fungicides can limit the activity of the diseases that control aphids.

Figure 9. Syrphid larva preying on aphids.

Figure 10. Aphid mummies (hardened, tan color).

Scouting and Economic Thresholds

Most vegetables should be scouted for aphids and other pests at least twice per week throughout the growing season. Pests often appear on field margins first, particularly those field edges near similar crops or weed hosts. Field margins should be checked because pests there may move into the field, but the numbers of pests in the margins should not be used as an indication of the overall population of the field. Scout in all quadrants of a field, inspecting several plants in each area. Check all leaves carefully. The lower leaf surface and plant terminal should receive close attention, as many aphid species prefer these sites.

Scientifically based economic thresholds have not been established for aphids on all cruciferous crops and commonly used action thresholds vary depending on the stage of the crop, season of the year, and the value of the crop. Broccoli and cauliflower can tolerate moderate aphid pressure before heading. Once these crops are heading, control is needed if only a few aphids are present. Cabbage generally has lower thresholds throughout the season because of the crop structure and the difficulty of controlling aphids with contact insecticides. Thresholds are also influenced by crop use; processed vegetables typically have lower thresholds than fresh market vegetables because the contamination regulations are stricter.

Figure 11. Carefully examine each leaf when scouting for pests.

Insecticidal Control

Figure 12. Insecticides are often a necessary part of aphid management, but should be used only when necessary and according to label instructions.

When aphid populations exceed acceptable levels and beneficial insect activity is low or rapid control is needed, insecticides become a necessary part of aphid management. There are many insecticides that control aphids on cruciferous crops. Choosing the best one is a matter of the speed and level of control necessary, the range of activity desired, and the cost. In general, the older broad-spectrum insecticides (organophosphates, carbamates, pyrethroids) kill more pests, work faster and cost less. Newer insecticides are generally more expensive and more selective, often controlling only aphids and other soft-bodied insects. Some of these products stop aphid feeding quickly, but don't kill the pests quickly. They generally have high levels of control and longer residual action. The selectivity of these insecticides is a disadvantage if several different pests must be controlled, but it is advantageous for preserving beneficial insects. Selective insecticides fit well in an IPM program.

Another advantage of some of the newer products is that they are systemic or locally systemic. This means that they penetrate leaf tissue or roots and move within the plant. Thus, thorough spray coverage is not as critical as it is with contact insecticides. This is particularly beneficial late in the season when coverage of some cruciferous crops is very difficult because of crop structure. Systemic insecticides also work better on distorted, aphid-infested plants, whose structure may protect aphids from contact insecticides. Also, some soil-applied systemic insecticides control aphids from 4 weeks to all season. They are used at planting to prevent aphid damage where the infestation potential and production history justify their use.

When insecticides are necessary, select them carefully. Aphids reproducing parthenogenetically produce offspring similar to themselves; thus, aphids that survive an insecticide are likely to produce aphids capable of surviving the same or similar insecticides. To manage resistance, rotate insecticides, selecting products with different modes of action and not just different insecticide groups or trade names.

Other factors to consider when selecting an insecticide are the pre-harvest interval and re-entry interval. Pesticide regulations and labels change rapidly, and the label should be read thoroughly before application. Carefully adhere to label instructions to get the best results with the least potential for harmful effects.

Field Identification Key for Common Aphids on Cruciferous Crops

(A 10-20x magnification hand lens will be helpful.)

1. a. Aphids found on leaves, normally on the lower leaf surface; cornicles elongate; cauda distinct; antennae long with six segments (Fig. 1-A, B) 2

   b. Aphids found on ground surface in crevices or cracks, or in soil, feeding on roots; often in clusters with white waxy secretions; body oval, yellow or dirty pale yellow, covered with a thin layer of whitish powder; cornicles absent; antennae very short; winged forms are found in the field only as they migrate to or from cottonwood or poplar trees . . . . . .Poplar petiole gall aphid (Cabbage root aphid)

2. a. Body heavily covered with white waxy powder; dorsal surface of abdomen with segmental pattern of pigmentation anterior to the cornicles; infested leaf surface with distinct white waxy powder . . . . . .Cabbage aphid

   b. Body not heavily covered with waxy powder; infested leaf surface without white waxy powder 3

3. a. Frontal tubercles distinct at the vertex inside the base of the antennae (Fig. 14A, C, D) 4

   b. Frontal tubercles not distinct (Fig. 14B); body yellowish to dark green to nearly black; cornicles black . . . . . .Cotton aphid (Melon aphid)

4. a. Frontal tubercles pronounced, converging (Fig. 14A); cornicles long, > 2 times the length of the cauda; abdominal dorsum of winged form with dark patch; aphids feeding on lower leaf surface in small clusters . . . . . .Green peach aphid

   b. Frontal tubercles diverging, not distinctly exceeding vertex (Fig. 14C); abdominal dorsum of winged aphids without abdominal patch; aphids feeding on lower leaf surface in large clusters; thin layer of white waxy powder; dorsal surface of abdomen without pigmentation anterior to cornicles; infested leaf surface without white waxy powder . . . . . .Turnip aphid

Microscopic Identification Key for Aphids on Cruciferous Crops

(A stereomicroscope with >40x magnification may be needed to accurately identify live specimens; or use a compound microscope for specimens mounted on microscopic slides.)

Wingless adults (apterae):

1. a. Cornicles present and elongate; antennae long, six segments (Fig. 1B) 2

   b. Cornicles absent or porelike; antennae short, five segments; aphids feeding on roots . . . . . .Poplar petiole gall aphid (Cabbage root aphid)

2. a. Frontal tubercles well developed and distinct (Fig. 14A, C, D) 3

   b. Frontal tubercles not well developed (Fig. 14B); cornicles with distinct flange (Fig. 15B); cauda slightly knobbed with five to seven setae (Fig. 16Bb) . . . . . .Cotton aphid (Melon aphid)

3. a. Frontal tubercles pronounced, converging (Fig. 14A); cornicles >1.5 times longer than cauda . . . . . .Green peach aphid

   b. Frontal tubercles diverging, not distinctly exceeding vertex (Fig 14C, D) 4

4. a. Cornicles distinctly longer than cauda; cauda tongue-shaped (Fig 16Cb) . . . . . .Turnip aphid

   b. Cornicles shorter than cauda; cauda cone-shaped or broadly triangular in dorsal view, with seven to eight setae (Fig. 16Db) . . . . . .Cabbage aphid

Winged adults (alate):

1. a. Cornicles present and elongate; antennae long, six segments; front wing vein M with three branches (Fig. 1A) 2

   b. Cornicles absent or pore-like; antennae short with five segments; front wing vein M not branched; pores present on dorsal surface . . . . . .Poplar petiole gall aphid (Cabbage root aphid)

2. a. Frontal tubercles well developed and distinct (Fig. 14A, C, D) 3

   b. Frontal tubercles not well developed (Fig 14B); cornicles with distinct flange (Fig 15B); cauda slightly knobbed with five to seven setae (Fig. 16Ba) . . . . . .Cotton aphid (Melon aphid)

3. a. Frontal tubercles pronounced, converging (Fig. 14A); abdominal dorsum with dark patch; cornicles pale, >1.5 times longer than cauda . . . . . .Green peach aphid

   b. Frontal tubercles diverging, not distinctly exceeding vertex (Fig 14C, D); abdominal dorsum without abdominal patch 4

4. a. Cornicles distinctly longer than cauda; cauda tongue-shaped (Fig. 16Ca) . . . . . .Turnip aphid

   b. Cornicles shorter than cauda; cauda cone-shaped or broadly triangular in dorsal view, with seven to eight setae (Fig. 16Da) . . . . . .Cabbage aphid

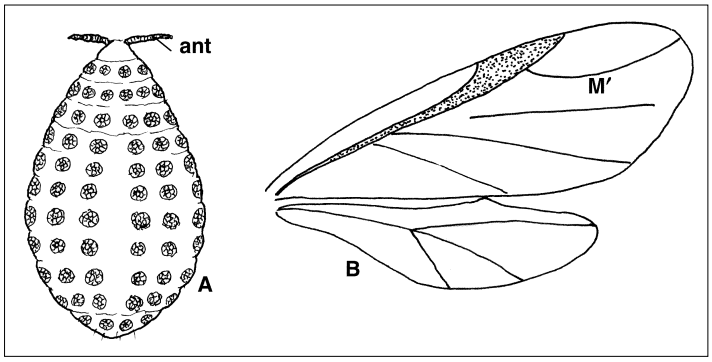


Figure 13. General root aphid. A—wingless adult, B—wing venation. ant=antennae, M′=median wing vein.

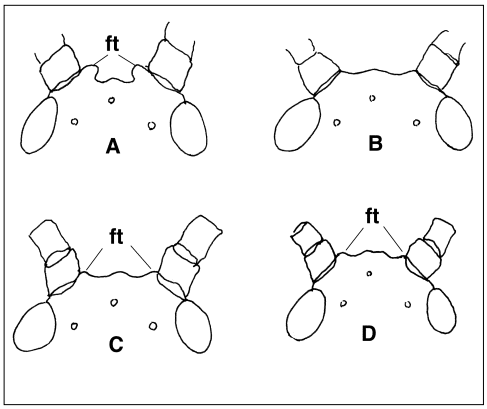


Figure 14. Frontal area of foliar aphid species. A—Green peach aphid, B—Cotton aphid, C—Turnip aphid, D—Cabbage aphid. ft=frontal tubercle.

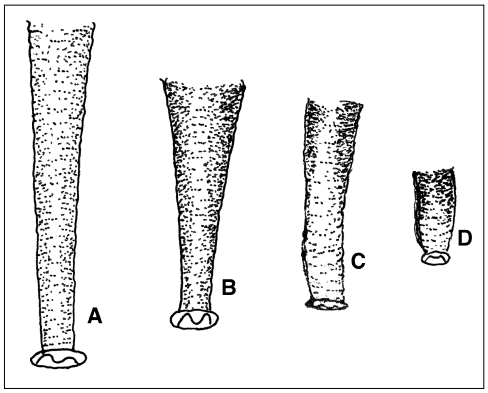


Figure 15. Cornicles of foliar aphid species. A—Green peach aphid, B—Cotton aphid, C—Turnip aphid, D—Cabbage aphid.

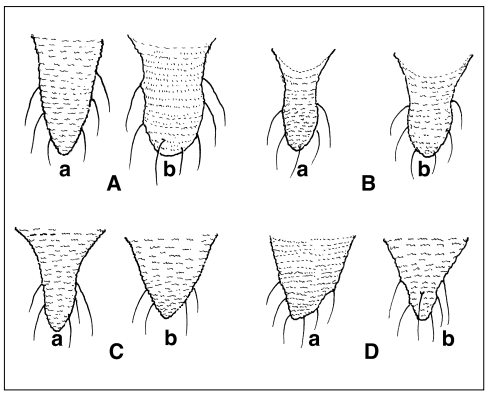


Figure 16. Cauda of winged (a) and wingless (b) foliar aphid species. A—Green peach aphid, B—Cotton aphid, C—Turnip aphid, D—Cabbage aphid.

Cabbage aphid

Brevicoryne brassicae (Linnaeus)

Wingless adults of the cabbage aphid are dull green, yellow green, or gray green. This aphid forms large colonies covered by a white or grayish, waxy, powdery secretion. Only newly molted aphids lack the secretion. It is much lighter on winged adults than on wingless adults. Pigmentation on the dorsal surface of the abdomen gives a segmented appearance. The wingless nymphs resemble the adults in color and shape but are smaller. The winged adults are slightly larger, pale green to yellow green, with a dark brown to black head and thorax.

The distincitve characteristics of the cabbage aphid are:

- the cornicles are shorter than the cauda;
- the cauda is cone-shaped or triangular with seven to eight curved hairs; and
- a white, waxy secretion covers the aphids and infested leaves.

The cabbage aphid is usually not a major pest in South Texas. Cabbage aphids prefer young leaves and can be found on the upper and lower surfaces of leaves and within the heads of cabbage. This places cabbage aphid colonies in or near the harvested portion of the crop. The aphids and their honeydew, sooty mold and waxy secretion can make the crop unmarketable. Contamination is often the greatest economic damage this pest causes.

The cabbage aphid feeds on wild and cultivated cruciferous crops including cabbage, collards, broccoli, brussel sprouts, cauliflower, kale and radish. Mustard and other leafy greens are rarely, if ever, infested.

Cotton aphid (Melon aphid)

Aphis gossypii Glover

Cotton aphids, also called melon aphids, are yellowish green, to dark gray, to dark green or black. Cotton aphids can form large colonies and are not covered with waxy secretions. They usually prefer the undersides of leaves, but when populations are high entire plants can be covered. In South Texas, all forms (winged or wingless) are females that reproduce parthenogenetically (without mating). The yellowish forms are generally seen during hot seasons (summer and early fall); the dark or black forms are seen during cooler seasons. Winged females are produced if there is a large, overcrowded population.

Characteristics of this species are:

- cornicles and cauda are dark to black;
- there are no frontal tubercles;
- the length of the cauda is shorter than one-half the length of the cornicles; and
- the cauda is slightly knobbed and has five to seven curved hairs.

The cotton aphid is a common pest on hundreds of agronomic and horticultural crops. It can be found on cruciferous crops at any time of the year, but is not normally considered a major pest on cruciferous crops.

Green peach aphid

Myzus persicae (Sulzer)

Green peach aphids are pale yellow to green and are usually found on the undersides of older leaves. Individual aphids are scattered on the leaf surface and seldom form colonies. Adults are usually wingless. The antennae and cornicles are the same color as the body, but slightly darker at the end. The winged adult female has a yellowish-green abdomen with a dark dorsal blotch or patch. This species differs from other aphid species found on crucifers in that the antennal tubercles are prominent and pointed inward, and the cornicles are swollen near the base. Nymphs are similar to adults in shape and color but are smaller.

The major characteristics that separate this species are:

- the distinct frontal tubercles point inward;
- cornicles are the same color as the body; and
- cornicles are longer than the cauda.

The green peach aphid has a very wide host range and is an important pest on crucifers and other leafy vegetables. Its hosts include cabbage and related cruciferous crops, dandelion, endive, mustard greens, parsley, turnip, tomato, tobacco, potato, spinach, pepper, beets, celery and lettuce.

Turnip aphid

Lipaphis erysimi (Kaltenbach)

Wingless adult turnip aphids are varying shades of green and have slightly darker spots on the dorsal surface of the abdominal segments in front of the cornicles. These aphids have a slightly visible thin layer of white, waxy secretions (much less than the cabbage aphid). Winged females have

dusky green abdomens with dark lateral stripes. The antennae are also dark, except at the base.

Major characteristics are:

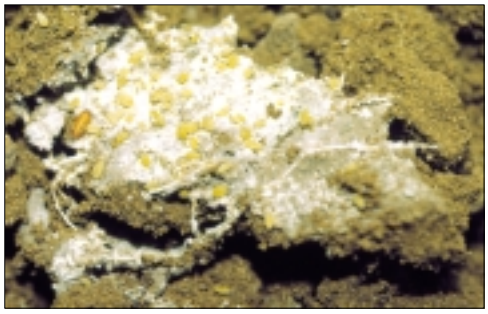
- frontal tubercles do not converge;
- cornicles are not dark and longer than the cauda;
- the cauda is tongue-shaped; and
- colonies have a thin layer of white, waxy secretion.

The turnip aphid is the major aphid pest of cruciferous crops in South Texas. It occurs throughout the production season. These aphids form large colonies on the undersides of leaves. Heavy infestations stunt plant growth and can turn plants yellowish. Turnip aphids can prevent cabbage plants from making marketable heads. Heavy infestations can kill small plants or seedlings. Large colonies on harvested vegetables reduce marketability.

Turnip aphid hosts include mustard, radish, turnip, watercress and other crucifers, particularly in the seedling stage.

Poplar petiole gall aphid (Cabbage root aphid)

Pemphigus populitransversus Riley



The poplar petiole gall aphid is readily identified by its habits. Adults and nymphs feed on the roots of some cruciferous crops. The wingless adult is oval and a dirty pale yellow with dusky head and appendages. These aphids also secrete a white wax, which covers the aphid colonies on the roots. With moderate to heavy infestations, this waxy secretion is evident on the soil surface around the base of infested plants. A key characteristic of this aphid is the pore-like cornicles, which make them seem to lack cornicles. Winged adults have five-segmented antennae and the median vein in the front wing is not branched.

The poplar petiole gall aphid has an annual cycle that requires it to switch hosts during the year. It attacks poplar trees in the spring, causing galls on the leaf petioles. Both sexual and asexual reproduction occurs on poplars. In the late summer and fall, winged adults move to cruciferous crops where they feed on the roots and reproduce parthenogenetically.

Because of this pest's unique biology, planting dates can greatly influence infestation levels. Crops planted before the aphids move to cruciferous crops in the fall can be heavily infested. Often such crops are treated at planting with soil insecticides. Planting after the fall migration greatly reduces the potential for problems with this pest.

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