

BRASSICA PESTS & THEIR NATURAL ENEMIES

A FIELD GUIDE FOR
TEXAS ORGANIC FARMERS



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Introduction

This guide is intended to help Texas farmers recognize and control major brassica pests using environmentally friendly methods. Several beneficial insects are included, since they play a key role in any organic management plan. Also called crucifers, brassicas are crops in the mustard family, such as cabbage, collards, cauliflower, broccoli, brussels sprouts, and kale.

Terminology

- Scientists classify living things by kingdom, phylum, class, order, family, genus, and species. Except for a few spiders and mites, everything in this guide is an insect, falling into one of 28 orders in the class *Insecta*.
- In scientific names given here, the first word (capitalized) is the genus and the second word is the species. When the genus is followed by “spp.” it means we are talking about multiple species of that genus.
- Insects with four distinct life stages (egg, larva, pupa, and adult) are said to have a *complete metamorphosis*. Insects (such as whiteflies, aphids, and thrips) without a pupa (resting) stage have an *incomplete* or *gradual metamorphosis*. Larvae (often also called *nymphs*) go through a series of moults and growth stages (called *instars*).

Scouting

- All farmers should scout for pests at least once or twice per week. Because they have fewer allowed treatment options, organic farmers need to be especially vigilant, catching infestations at an early stage.
- The sheer number of insect species can be intimidating, but the vast majority are either beneficial or neutral. This guide includes all the brassica pests on Texas A&M University's IPM Program website.
- Many insects are small and hard to see, while others are highly variable in color and markings. Many times a “probable” identification is the best you can do in the field. This can often be accomplished simply by studying leaf damage and other clues.

- Knowing the exact species is sometimes important but usually unnecessary for practical purposes. For example, almost all ladybugs are beneficial. And organic treatment options are similar for all aphid species.
- If you need a high degree of precision or certainty, identification keys are readily available on the Internet and from your local Texas A&M AgriLife Extension office—your best source of expert help.
- Organic farming requires an attitude of working with insects, not going to war with them. Once beneficials are established, rely on them as your main line of defense. Promote biodiversity, including a wide variety of flowering plants as habitat for beneficials.
- Pest infestations are often a sign of plant stress or unhealthy soil. Generally use broad-spectrum insecticides (such as neem oil) as a last resort, since these products kill beneficials along with pests and don't address the root cause of the problem.
- On certified organic land, be very sure that any product you apply is allowed. Even one application of a prohibited substance can result in loss of certification. Check with your certifying agent if there is any doubt.
- This guide does not include numerical treatment thresholds: indicators such as a number of insects per plant that should trigger control measures. Research on organic farming in Texas to date has been limited, and few if any reliable treatment thresholds have been published.
- This guide also does not cover plant diseases at all. Scouting for diseases is just as important as monitoring insects.

Habitat Management

[To be added by Carlo]

- YYYYYYYYYYYYYY
- ZZZZZZZZZZZZZZZZ
- aaaaaaaaaaaaaaaaaa

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Preferred foods of major brassica pests†

	Broccoli	Cabbage	Cauliflower	Greens
Cabbage Looper				
Beet Armyworm				
Aphids				
Sweet Potato Whitefly				
Harlequin Bug				
Diamondback Moth				
Onion Thrips				
Western Flower Thrips				
Granulate Cutworm				
Flea Beetle				
Imported Cabbage Worm				
Spider Mites				

† Information in this table comes from the Texas A&M University Vegetable IPM website, <http://vegetableipm.tamu.edu>.

CABBAGE LOOPER

Trichoplusia ni (order *Lepidoptera*)



Identification: Larva is greenish with pale stripes. It has no legs in the middle portion of its body, and walks by forming its body into a loop and then throwing its body forward. It is the only member of the “looper” family that concentrates on brassicas. The adult moths have silvery markings in the middle of their front wings, in the shape of a sock or a figure-8. Eggs are usually laid singly, have ridges, and look like pale green barrels or globes.

Damage: Larvae chew large ragged holes in leaves, preferring older leaves. Young plants can withstand considerable leaf damage without yield loss. So generally there is no need to treat healthy, well-established plants unless you find several larvae per plant. Greatest damage occurs after heading, when larvae bore through the heads.

Scouting: Adult moths appear in mid-spring. There are three or four generations per year, each taking 3-4 weeks to mature. Look for larvae and eggs on the underside of leaves. Pheromone traps are available to catch adult moths.

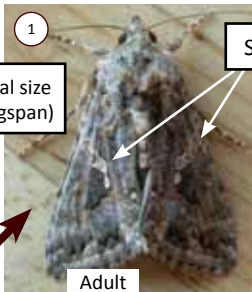
Organic treatments: Very susceptible to *Bacillus thuringiensis* (Bt). Time treatments to control young larvae, as the older ones are hard to kill.

Natural enemies: Damsel bugs, paper wasps, spiders, tachinid flies, and various parasitic wasps (such as trichogramma).

Photos: (1) K. Naylor, Bugwood.org; (2,3) W. Cranshaw, Colorado State Univ, Bugwood.org; (4 & 6) D. Riley, Univ of Georgia, Bugwood.org; (5) R.J. Reynolds Tobacco Company, Bugwood.org.

CABBAGE LOOPER

Trichoplusia ni (order *Lepidoptera*)



1

Silvery white figure-8s

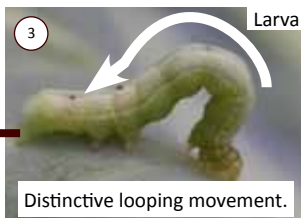
Approx actual size
(1.5"-2" wingspan)

Adult



2

Eggs



3

Larva

Distinctive looping movement.



6

Pupa



5

Damage

Maximum
larva size



4

BEET ARMYWORM

Spodoptera exigua (order *Lepidoptera*)



Identification: The adult is hard to tell from numerous other mottled brown moths, but larvae are quite identifiable: usually olive green with light stripes down the back and sides of smooth body. There is usually a dark spot on the body above the second pair of true legs. The smallest larvae feed in groups, unlike other common vegetable pests. Eggs are laid in large masses of up to 80 eggs.

Damage: Larvae will defoliate entire leaves, but serious economic damage to brassicas is reportedly somewhat uncommon in Texas. Small plants can withstand considerable leaf damage without yield loss.

Scouting: Check for fluffy egg masses and young larvae in weeds surrounding the field in early season. If populations are high, watch carefully for egg masses and larvae on young crops, checking at least twice a week. Pheromone traps are available to capture adult moths, helping to predict egg laying.

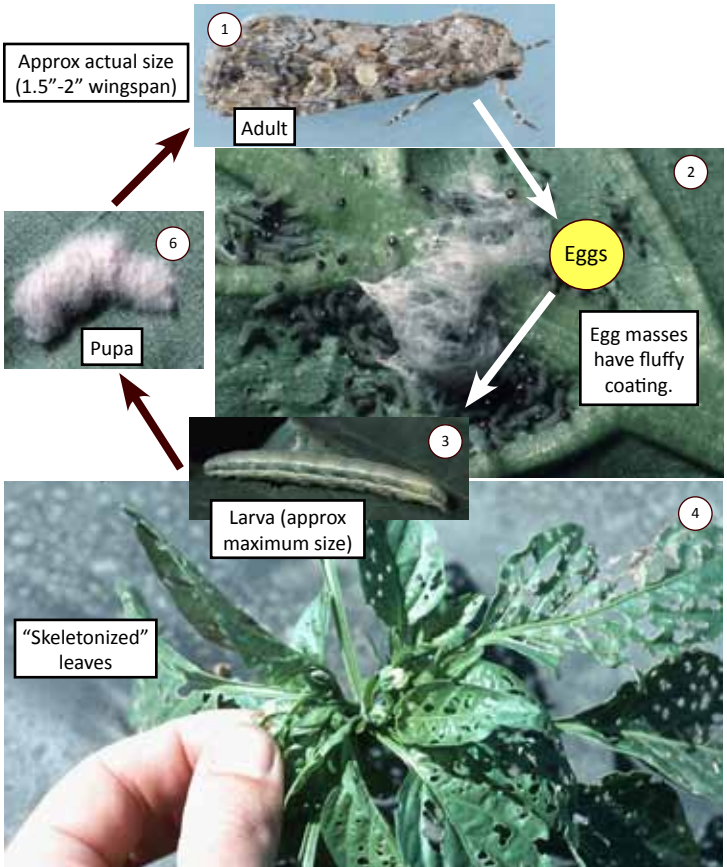
Organic treatments: *Bacillus thuringiensis* (Bt) is somewhat effective, but less so than on some other caterpillars. The variety Bta (*Bacillus thuringiensis aizawai*) is most effective. Orange oil and neem will kill beet armyworms on contact. Treatment is usually not needed between thinning and heading, but may be necessary just before heading if the marketable portion of the crop is at risk.

Natural enemies: Parasitic flies (such as tachinid flies), parasitic wasps, and ground beetles.

Photos: (1) M. Dreiling, Bugwood.org; (2, 3, & 6) A. N. Sparks, Jr., U. of Georgia, Bugwood.org; (4) D. Riley, U. of Georgia, Bugwood.org.

BEET ARMYWORM

Spodoptera exigua (order *Lepidoptera*)



APHIDS

Aphididae spp. (order *Homoptera*)



Identification: Aphids are unique in having tubes (cornicles) protruding from their abdomens, through which they secrete yellowish “honeydew.”

Damage: Aphids pierce leaves or stems, drink sap, and can burrow deep into plant heads, becoming impossible to wash out. Honeydew grows a sooty mold. The turnip, green peach, and cabbage root aphids are the most damaging to brassicas in Texas, followed by the cabbage aphid and cotton aphid. Aphids produce up to 50 generations per year, and populations can explode. See following pages for species identification.

Scouting: At least twice per week, check undersides of leaves, leaf/stem terminal, and tip growth. Look for honeydew, yellow spots on leaves, cast skins, curling leaves, ant clusters, or dead aphids—showing that beneficials are taking a toll. Aphids don’t move much, allowing close inspection.

Organic treatments: Similar for all aphids: pressurized water spray, garlic-pepper tea, liquid seaweed, orange oil, other plant oil products, insecticidal soap, neem products, and *Beauveria bassiana*.

Natural enemies Aphids are under constant attack by lacewings, ladybugs, syrphid fly larvae, parasitic wasps, and many others. Support aphid predators by avoiding the use of broad spectrum insecticides.

Photo: Zoe Carlberg, NCAT.



TURNIP APHID

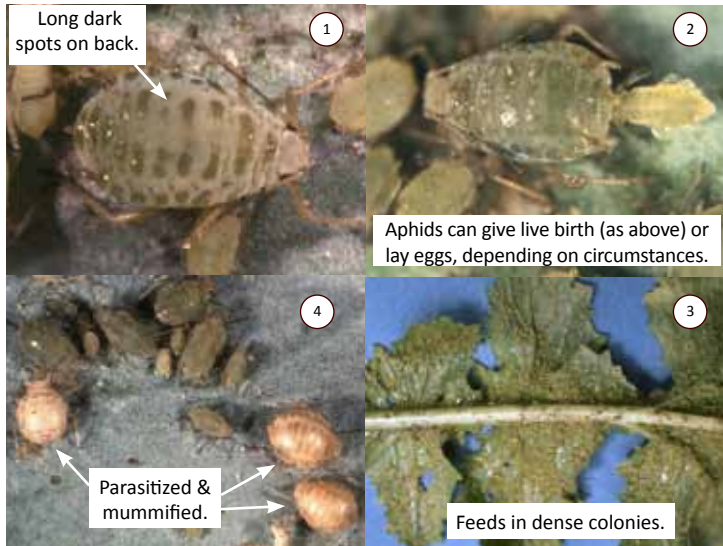
Lipaphis erisymi (order Homoptera)



Identification: Turnip aphids (also called mustard aphids) are greenish and have long dark markings on their back. They feed in large clusters and have a small amount of white waxy powder on their bodies, but little if any of this powder is deposited on the leaf surface.

Damage: Some researchers consider turnip aphids to be the major aphid pest of brassicas in South Texas.

Photos: (1-2, 4) Alton N. Sparks, Jr., University of Georgia, Bugwood.org; (3) Eugene E. Nelson, Bugwood.org.



GREEN PEACH APHID

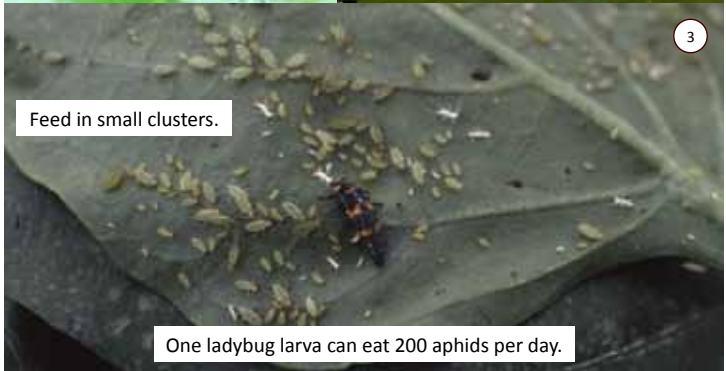
Myzus persicae (order Homoptera)



Identification: Pale yellow to green, feed in small clusters, prefer underside of older leaves, and are not covered in white powder. Differ from cotton aphids in having long cornicles that are the same color as their bodies.

Damage: Feed on a wide variety of crops and are a serious brassica pest.

Photos: (1) S. Bauer, USDA-ARS, Bugwood.org; (2) D.Cappaert, Michigan State Univ, Bugwood.org; (3) D. Riley, Univ. of Georgia, Bugwood.org.



CABBAGE ROOT APHID

Pemphigus populitransversus (order Homoptera)



Identification: Cabbage root aphids (also called poplar petiole gall aphids) are yellowish, feed in clusters on roots (not usually leaves), and secrete white wax that accumulates on roots and around the base of the plant. Their cornicles do not protrude at all, looking like openings in the body.

Damage: Winged aphids leave poplar tree galls (where they are born) in the summer. Their wingless offspring infest brassica roots, sometimes causing stunted growth. Major problems occur mainly in crops planted in September, and can often be avoided by planting earlier or later.

Photos: (1-2) H. A. Pase III, Bugwood.org; (3) A. N. Sparks, Jr., Univ. of Georgia, Bugwood.org.



1
Reproduce inside poplar tree galls.



2
Breaking open gall to reveal aphids.



3
Leave white waxy mess on roots.

COTTON APHID

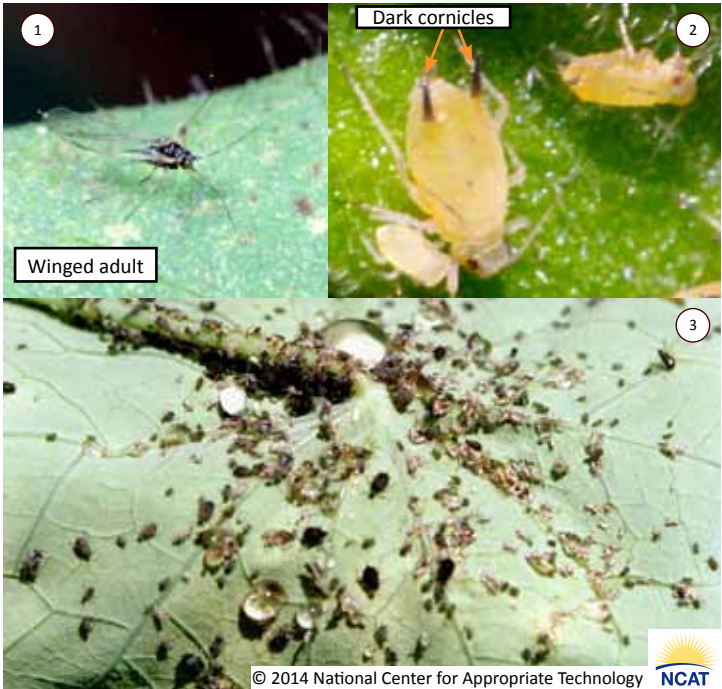
Aphis gossypii (order Homoptera)



Identification: Cotton aphids (also called melon aphids) are yellow, dark green, or blackish. They are not covered in white powder, and have blackish cornicles—differentiating them from green peach aphids.

Damage: Feed on a wide range of crops, including brassicas.

Photos: (1,3) Clemson Univ/USDA CES, Bugwood.org; (2) ©2009 Tim Lethbridge, bugguide.net.



CABBAGE APHID

Brevicoryne brassicae (order Homoptera)

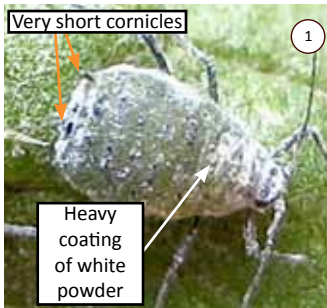


Identification: Greenish-gray or yellowish-green with very short cornicles. Wingless adults are covered in white powder, which piles up like dust on leaves. Form dense colonies on the youngest leaves. They feed mainly on brassicas, but are almost never found on mustard or other leafy greens.

Damage: Cause stunting and yellowing of leaves. High populations cause distortion of cabbage heads.

Natural enemies: Powder seems to make them less desirable to ladybugs.

Photos: (1,3) ©2009 R. Berg, bugguide.net; (2) D. Cappaert, Michigan State Univ, Bugwood.org; (4) A. N. Sparks, Jr., Univ of Georgia, Bugwood.org.



SWEET POTATO WHITEFLY

Bemisia tabaci (family *Aleyrodidae*, order *Homoptera*)



Identification: The major whitefly pest for brassicas in Texas is the sweet potato whitefly, also called the silverleaf whitefly. (Until recently these were considered two separate species.)

Damage: Major pest of brassicas, potatoes, tomatoes, squashes, and many other plants. Adults and larvae suck sap out of plant leaves, secrete honeydew, and can cause blanching of broccoli stalks. A major concern with whiteflies is their tendency to spread viral diseases.

Scouting: At least twice per week, check the undersides of leaves. In the field, a swarm of whiteflies will often take flight as you approach an infested plant, looking like a cloud of whitish dust. The adults are strongly attracted to yellow sticky traps. Larvae do not move, allowing close inspection.

Organic treatments: Insecticidal soap, neem oil, garlic tea, garlic-pepper tea, seaweed, manure compost tea, molasses, citrus oil, and *Beauveria bassiana* (beneficial fungus). The underside of the leaf must be covered thoroughly for effective treatment.

Natural enemies: Green lacewings, ladybugs, pirate bugs, big-eyed bugs, damsel bugs, and parasitic wasps.

Photos: (1) Central Science Laboratory, Harpenden Archive, British Crown, Bugwood.org; (2) Clemson Univ/USDA CES, Bugwood.org; (3) P. Roberts, U. of Georgia, Bugwood.org; (4) W. Billen, Pflanzenbeschaustelle, Weil am Rhein, Bugwood.org

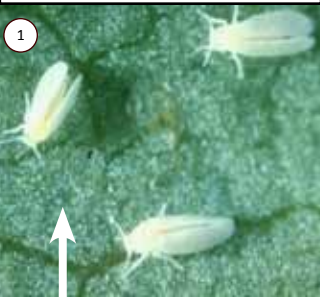
SWEET POTATO WHITEFLY

Bemisia tabaci (family Aleyrodidae, order Homoptera)



Adults look like tiny whitish moths.

1



Actual adult size →

Larvae

2

First instar has legs. Instars 2-4 are legless and look like scales.

4

Final stage larva (4th instar)



3



HARLEQUIN BUG

Murgantia histrionica (order Hemiptera)



Identification: Brightly colored orange and black members of the stink bug family, harlequin bugs are easy to identify, although sometimes confused with similar twospotted stink bug. Unique eggs are barrel-shaped, black and white striped, and laid in clusters of 10 or more.

Damage: Has been called the most important pest of crucifer crops in the South. Nymphs and adults feed heavily on all members of the brassica family, causing yellow or whitish blotches and distorted growth. Harlequin bugs take two months to reach adulthood, and only one or two generations per year are produced.

Scouting: Adult bugs seek shade and are easiest to find in the early morning. Also look for leaves with a tattered appearance.

Organic treatments: Harlequin bugs are hard to kill with insecticides. Manure compost tea, seaweed, molasses, vinegar, and citrus oil are options to consider. You can divert them from broccoli, cabbage, and cauliflower to mustards and radish (which they strongly prefer). Also plant resistant varieties.

Natural enemies: Predators that eat harlequin bug eggs have the greatest impact. Once the eggs have hatched, larvae and adults have few natural enemies.

Photos: (1) W. Upham, Kansas State Univ, Bugwood.org; (2) © 2012 Bob Barber, bugguide.net; (3-4) W. Cranshaw, Colorado State University, Bugwood.org.

HARLEQUIN BUG

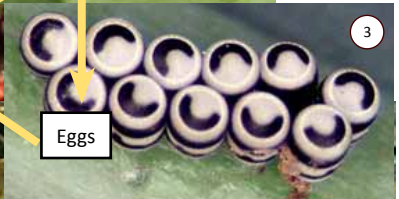
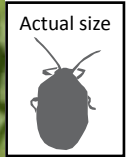
Murgantia histrionica (order Hemiptera)



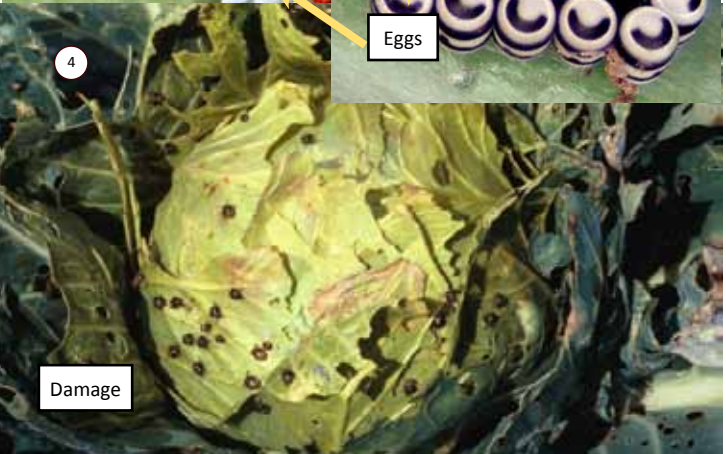
Nymphs



Adult



Eggs



Damage

DIAMONDBACK MOTH

Plutella xylostella (order *Lepidoptera*)



Identification: Larvae are greenish yellow, slender, tapered at both ends, and have a forked tail. They are much smaller than cabbage loopers, rarely more than 5/16" long. They tend to drop on a silk thread when disturbed. They also wiggle violently when disturbed, an identifying feature that distinguishes them from other worms commonly found on brassicas. Eggs are football-shaped and pale yellow or white, laid singly or in small groups on the underside of leaves.

Damage: Even though the larvae are small, large populations do serious damage. Larvae chew irregular holes in leaves.

Scouting: Diamondback moths overwinter as adults in Texas, and are one of the first insects to be active in the spring. Several generations (4-6 weeks) are completed per year..

Organic treatments: Like most members of the order *Lepidoptera* (moths and butterflies), diamondback moths are susceptible to *Bacillus thuringiensis* (Bt).

Natural enemies: Parasitic wasps, spiders, damsel bugs, and other insect predators.

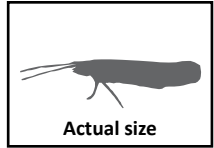
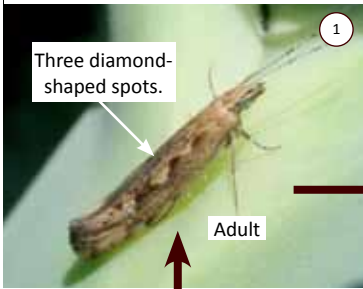
Photos: (1) R. Ottens, Univ of Georgia, Bugwood.org; (2) D. Cappaert, Michigan State Univ, Bugwood.org; (3) W. Cranshaw, Colorado State Univ; (4) M. Shepard, G. R.Carner, P.A.C Ooi, Insects & their Natural Enemies Associated with Vegetables & Soybean in Southeast Asia, Bugwood.org.

DIAMONDBACK MOTH

Plutella xylostella (order *Lepidoptera*)



Slender moth with long thick antennae.



Eggs

Maximum larva size:

Larva



THRIPS

Thrips tabaci & *Frankliniella occidentalis* (order *Thysanoptera*)



Identification: Thrips adults are tiny pale yellow, tan, or blackish cigar-shaped insects with fringed, feather-like wings. They sometimes bite when captured (feeling like a pin prick). Nymphs are usually light green or yellow.

Damage: Adults and larvae suck juices from plants. Onion thrips (*Thrips tabaci*) feed on leaves, causing distinctive silvery or brownish streaks (scarring wounds). The western flower thrips (*Frankliniella occidentalis*) feeds mainly on flowers, causes only minor leaf scarring. It provides a service by eating spider mites, but is a major transmitter of viruses. Up to 15 generations take place each year.

Scouting: Adults often leap or fly away when approached. Baby blue sticky traps are best for capturing adults, but yellow traps also work.

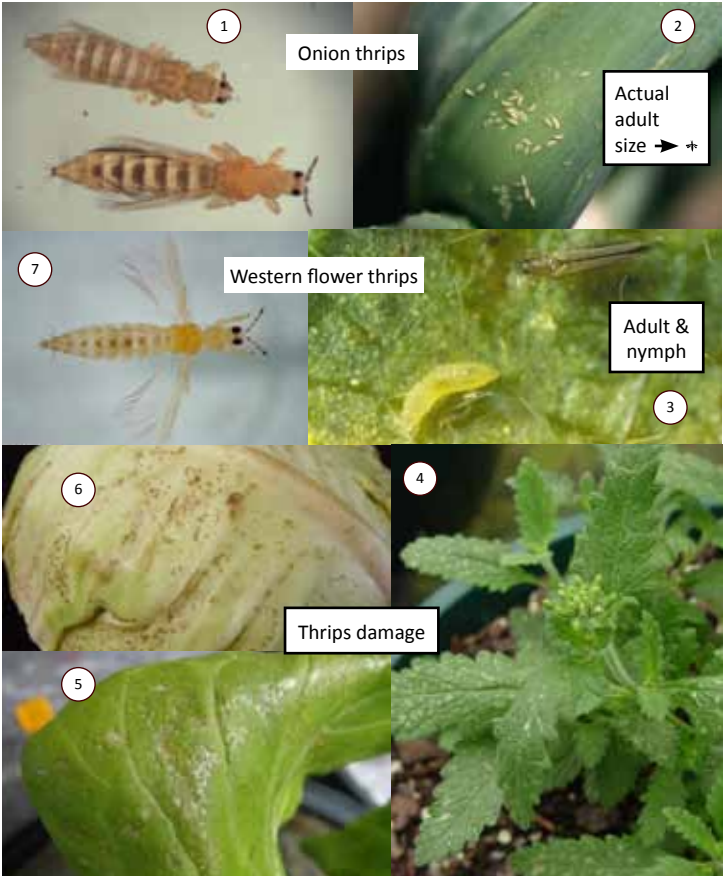
Organic treatments: Plant oil, garlic tea, seaweed spray, floating row covers, and *Beauveria bassiana* are options. Plant thrips-tolerant varieties. Avoid planting brassicas near alfalfa, clover, or alliums (onion family), since these harbor large populations of thrips. Release the predatory mite *Amblyseius cucumeris* or pirate bugs. Deter onion thrips with kaolin clay. As a last resort, dust the undersides of leaves with diatomaceous earth or spray with neem.

Natural enemies: Big-eyed bugs, minute pirate bugs, lacewings, ladybugs, and predatory thrips. Heavy rains and overhead irrigation devastate thrips, and they tend to build up in dry weather.

Photos:(1) A. Sparks, Univ of Georgia, Bugwood.org; (2) W. Cranshaw, Colorado St. Univ., Bugwood.org; (3&7) J. T. Reed, Mississippi State Univ, Bugwood.org; (4) C. Hesselein, Alabama CES, Bugwood.org; (5) M. Mirnezhad, Leiden Univ, Bugwood.org; (6) G. Holmes, Cal Polytechnic State U. at San Luis Obispo, Bugwood.org.

THRIPS

Thrips tabaci & *Frankliniella occidentalis* (order *Thysanoptera*)



1

Onion thrips

2

Actual adult size → +

7

Western flower thrips

Adult & nymph

3

6

Thrips damage

4

5



GRANULATE CUTWORM

Feltia subterranea (order *Lepidoptera*)



Identification: Members of the family *Noctuidae*. Adults are hard to tell from many similar large brownish moths. The larvae are fat and dull brown, with shiny heads. They curl up when disturbed.

Damage: Cutworms feed mainly at night, when they emerge from the soil and cut off the stems of tender young plants near ground-level. A single worm can destroy an entire row, although they usually do little or no harm to mature plants.

Scouting: Cutworms live in soil cracks or lie underground next to plant stems during the day. They can be seen at night with a flashlight, but are usually identified by their damage, or by digging around the base of damaged plants.

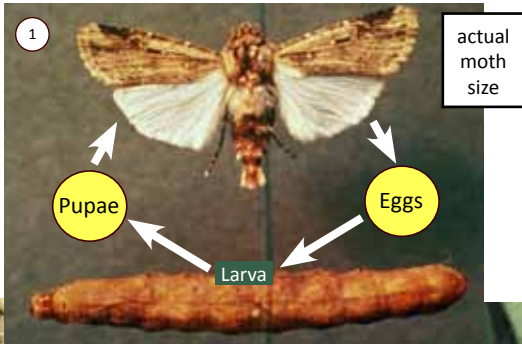
Organic treatments: Diatomaceous earth, *Bacillus thuringiensis* (Bt), beneficial nematodes, crushed red pepper, cedar flakes. Plant large transplants or set them out later in the year.

Natural enemies: Ground beetles, trichogramma wasps, fire ants, and parasitic nematodes.

Photos: (1) Univ of Georgia Archive, Bugwood.org; (2&4) J. C. French Sr., Retired:Auburn, Clemson, Univ of Missouri, Bugwood.org; (3) Clemson Univ/USDA CES, Bugwood.org.

GRANULATE CUTWORM

Feltia subterranea (order Lepidoptera)



FLEA BEETLE

(Family *Chrysomelidae*, order *Coleoptera*)



Identification: Flea beetle adults are the size of a pinhead and jump like fleas when disturbed. Larvae are whitish grubs with a dark head.

Damage: Adults chew small round or irregularly-shaped holes in leaves of numerous plants. They can transmit plant diseases. Larvae feed on roots, stems or leaves. Flea beetles are mostly a problem in early spring, when hungry adults emerge from the soil. Young plants can withstand considerable leaf damage without yield loss, and healthy, vigorous plants will usually “outgrow” flea beetle damage.

Scouting: Look for damage...as if someone shot leaves with buckshot. Adult flea beetles like full sun.

Organic treatments: Neem, citrus oil, kaolin clay, row covers, garlic spray, and *Beauveria bassiana*. Trap crops that have been used successfully include various mustards and pac choi.

Natural enemies: Some parasitic wasps are known to attack the adults.

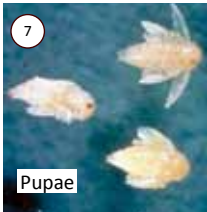
Photos: (1) Kansas Dept of Agriculture, Bugwood.org; (2) L.L. Berry, Bugwood.org; (3-5&7) Agriculture Canada, Ottawa Archive, Bugwood.org; (6) W, Cranshaw, Colorado State Univ, Bugwood.org

FLEA BEETLE

(Family *Chrysomelidae*, order *Coleoptera*)



Most adults are black, bluish, or brownish.



IMPORTED CABBAGE WORM

Pieris rapae (order *Lepidoptera*)



Identification: Introduced from Europe in the 19th century, imported cabbage worms are the most abundant and destructive cabbage worm throughout most of the U.S. but uncommon in the Deep South and rare in South Texas. Larvae are velvety green and have a thin yellow stripe down the back. The eggs are bullet-shaped yellow cones laid on the underside of leaves. The adult butterfly has black tips on the front wings and usually one or two blackish spots.

Damage: Feed mainly on brassicas, especially cabbage and broccoli. Larvae eat large ragged holes in leaves, contaminating heads with their droppings. Older larvae tunnel into the plant.

Scouting: Adults emerge in mid-spring and there are three to five generations per year. All stages of larvae are normally present throughout the growing season.

Organic treatments: *Bacillus thuringiensis* (Bt), garlic spray, hot pepper spray, or hand-picking. Overhead watering kills many small larvae. Floating row covers keep the butterflies from laying their eggs.

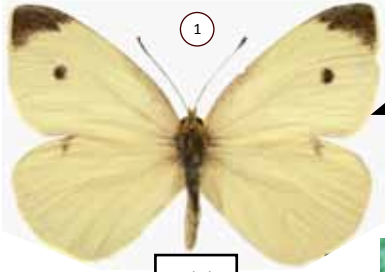
Natural enemies: Ground beetles, spiders, parasitic wasps, paper wasps.

A note about butterflies: Although a handful of moths (including the diamondback moth, cabbage looper, and cutworm) give order *Lepidoptera* a bad name, very few butterfly larvae are major agricultural pests. Almost all butterflies are also pollinators, albeit less efficient than bees.

Photos: (1) R. J. Bauernfeind, Kansas State Univ, Bugwood.org; (2,4) P. Sloderbeck, Kansas State Univ, Bugwood.org; (3) W. Cranshaw, Colorado State Univ, Bugwood.org; (5) Clemson Univ/USDA CES, Bugwood.org.

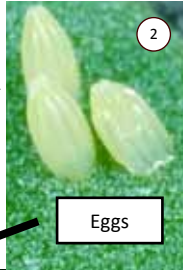
IMPORTED CABBAGE WORM

Pieris rapae (order *Lepidoptera*)



Approx actual size

Adult



Eggs



Larva



Pupa



Damage

TWOSPOTTED SPIDER MITE

Tetranychus urticae (order Arachnidae)



Identification: Extremely tiny (1/50 inch) eight-legged mites that are usually pale green or yellow.

Damage: Pierce plants and feed on sap from the underside of leaves. Early damage looks like yellow-speckled areas on leaves. Leaves turn silvery, bronze, or yellow, curl, and are eventually covered with a fine webbing. Spider mites attack mainly weak or sick plants.

Scouting: The mites themselves are tiny specks, barely visible to the naked eye. Look for leaf damage and webbing.

Organic treatments: Garlic-pepper tea, seaweed spray, citrus oil spray. Overhead watering and pressurized water spray knocks them from plants. Release predatory mites: *Phytoseiulus persimilis* or similar species. As a last line of defense, spray insecticidal soap or neem.

Natural enemies: Minute pirate bugs are one of the most aggressive enemies of spider mites. Predatory mites, ladybugs, thrips, and lacewings also eat spider mites.

Photos: (1) D. Cappaert, Michigan State Univ, Bugwood.org; (2) E. E. Nelson, Bugwood.org; (3,5) Clemson Univ/USDA CES, Bugwood.org; (4) J. C. French Sr.:Auburn Univ,, Clemson, and Univ of Missouri, Bugwood.org.

TWOSPOTTED SPIDER MITE

Tetranychus urticae (order Arachnidae)



LADYBUG

(Family *Coccinellidae*, order *Coleoptera*)



Identification: Familiar to almost everyone, there are several hundred species in North America, ranging from pale yellow to dark orange and even black, with or without spots. The larvae are similar to lacewing larvae but do not have large pincer mandibles found on lacewing larvae.

Benefits: Adults and larvae eat aphids, mealy bugs, mites, soft scale, and eggs of many insect pests. A ladybug larva can eat 200 aphids in a day.

Attract & maintain: Some plants that will attract ladybugs are

- members of the carrot family (such as fennel, angelica, dill, tansy, bishop's weed, and Queen Anne's lace);
- members of the mustard family; and
- members of the sunflower family (such as goldenrod, coreopsis, cosmos, golden marguerite (*Anthemis*), dandelion, sunflower, and yarrow);

as well as crimson clover, hairy vetch, grains and native grasses, butterfly weed (*Asclepias*), black locust, buckwheat, euonymus, rye, hemp sesbania (*Sesbania exaltata*), soapbark tree, buckthorn (*Rhamnus*), saltbush (*Atriplex spp.*), and black locust (*Robinia pseudoacacia*).

Keep pesticide use to a minimum. Neem oil, Bt, and many other pesticides will kill ladybugs. Ladybugs are commercially available, although outdoor releases often just fly away. Ladybugs will also leave the area when aphids move from a crop or are decimated by predators. To retain ladybugs, maintain cover crops or plantings that host aphids and other prey species.

Photos: (1) J. A. Payne, USDA ARS, Bugwood.org; (2) M. Shepard et al, Insects & their Natural Enemies Associated with Vegetables & Soybean in Southeast Asia, Bugwood.org (3) ©2011, Tom Murry, bugguide.net; (4,6) L. Tedders, USDA ARS, Bugwood.org; (5) L. Ingram, Bugwood.org; (7&8) Clemson Univ/USDA CES, Bugwood.org; (9) R. Ottens, Univ of Georgia, Bugwood.org.

LADYBUG

(Family *Coccinellidae*, order *Coleoptera*)



Adults shown actual size.

Many variations in spotting and color.



LACEWING

Hemerobius spp. & *Chrysopa* spp. (order Neuroptera)



Identification: Adults have tent-shaped, densely-veined, semi-transparent wings. Green lacewings are larger than brown lacewings. Larvae are mottled yellow or brown and have large sickle mandibles but are completely harmless and do not bite.

Benefits: Often called “aphid lions,” lacewing larvae are devastating predators of aphids, whiteflies, thrips, mites, loopers, mealy bugs, scale, and many other crop pests. A larva will eat as many as 600 aphids per day. The adults are not predators.

Attract & maintain: Some plants that will attract lacewings are

- members of the carrot family (such as caraway, Queen Anne’s lace, tansy, dill, and angelica); and
- members of the sunflower family (such as coreopsis, cosmos, sunflowers, dandelion, goldenrod);

along with buckwheat, corn, holly leaf cherry (*Prunus ilicifolia*), flowering bottle tree (*Brachychiton populneum*), and soapbark tree (*Quillaja saponaria*). Provide water during dry spells

Photos: (1) ©2010 R. Berg, bugguide.net; (2) ©2010 Lynette Schimming, bugguide.net; (3) Rex Dufour, NCAT; (4) J. Berger, Bugwood.org; (5) B. Higbee, Paramount Farming, Bugwood.org.

LACEWING

Hemerobius spp. & *Chrysopa* spp. (order Neuroptera)



Brown lacewing
(*Hemerobius*)



Shown
actual
size

Green lacewing
(*Chrysopa*)



Pupa (brown lacewing shown)



Green lacewing eggs
are laid on stalks.



4

Large sickle
mandibles



Larva (green lacewing shown)
Don't kill them!!



Actual size

SYRPHID FLY

Family *Syrphidae* (order *Diptera*)



Identification: Also known as hover flies, flower flies, hover bees, sweat bees, or sweat flies, syrphids are often mistaken for bees but do not sting or bite. They can be identified in the field by their steady hovering and quick flight pattern, resembling a hummingbird. Close inspection will reveal that they have two wings, whereas bees and wasps have four. The larvae range in color from whitish to gray to lime green.

Benefits: The primary diet of larvae is aphids. Adults eat nectar and pollen and provide a valuable service as pollinators. The adults do not prey on insect pests.

Attract & maintain: Some plants that will attract syrphids are

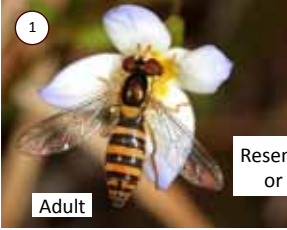
- members of the carrot family (such as Queen Anne's lace, dill, fennel, caraway, tansy, parsley, coriander, and bishop's weed); and
- members of the sunflower family (such as coreopsis, Gloriosa daisy, yarrow, cosmos, sunflower, and marigolds);

as well as candytuft, sweet alyssum, ceanothus, holly-leaved cherry (*Prunus ilicifolia*), buckwheat, scabiosa, spearmint, coyote brush (*Baccharis pilularis*), knotweed (*Polygonum aviculare*), soapbark tree, meadow foam (*Linnanthus douglasii*), and baby-blue-eyes (*Nemophila*).

Photos: (1) ©2007 David Silsbee, bugguide.net; (2&5) D. Cappaert, Michigan State Univ, Bugwood.org; (3) J Yuschock, Bugwood.org; (4) Cheryl Moorehead, Bugwood.org; (6) © 2009, Roy Sigafus, bugguide.net.

SYRPHID FLY

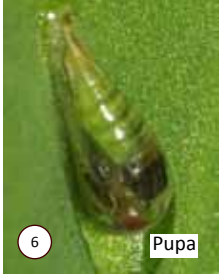
Family *Syrphidae* (order *Diptera*)



Resemble bees or wasps.



Wings often held horizontal when resting.



Eggs

Larvae can also be green.
Don't kill them!

PARASITIC WASP

(Order *Hymenoptera*)

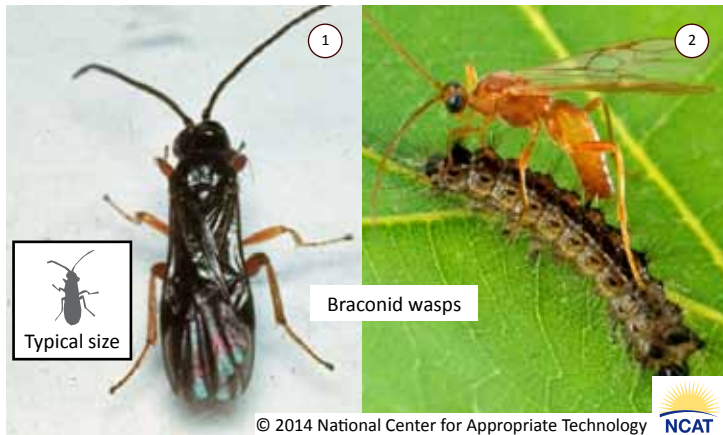


Identification: Most of the 2,000+ North American parasitic wasp species are very small and unlikely to be seen in the field. Braconid wasps are 1/16th to 5/8th inch long, and trichogramma wasps are just 1/50th inch. Ichneumon wasps are similar in size and appearance to braconids.

Benefits: Parasitize and kill cabbage looper, beet armyworm, imported cabbage moth, diamondback moth, cutworms, aphids, whiteflies, and many others.

Attract & maintain: Some plants that will attract parasitic wasps are nectar plants with small flowers (such as caraway, dill, parsley, Queen Anne's lace, fennel, mustard, white clover, tansy, or yarrow), as well as sunflowers, hairy vetch, buckwheat, cowpea, common knotweed, crocuses, and spearmint.

Photos: (1) R.J. Reynolds Tobacco Co., Bugwood.org; (2) Scott Bauer, USDA ARS, Bugwood.org.



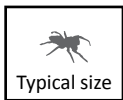
JUMPING SPIDER

Family *Salticidae* (order *Arachnida*)



Identification: There are around 300 known jumping spider species in North America. Their eye pattern is the most distinctive feature. They have a flat face with 4 of their 8 eyes facing forward. Many other spiders are also effective at controlling pests.

Photo: © 2014 Kenneth Frank, bugguide.net



Flat face with forward-looking eyes.



ASSASSIN BUG

Family *Reduviidae* (order *Hemiptera*)

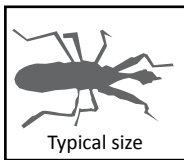


Identification: There are about 150 known North American species, and thousands worldwide. Many (but not all) have long, narrow necks.

Benefits: Assassin bugs are general predators that kill flies, caterpillars, and many kinds of insects.

Attract & maintain: Permanent plantings for shelter, e.g. hedgerows.

Photo: © 2010 Kenneth Frank, bugguide.net



BIG-EYED BUG

Geocoris sp. (order Hemiptera)



Identification: Eyes are very large; encompassing a large percentage of total body size. Also look for small black spots on the head and thorax.

Attract & maintain: Attract big-eyed bugs with cool-season cover crops such as berseem clover (*Trifolium alexandrium*) and subterranean clovers (*Trifolium subterraneum*). Big-eyed bugs are also found on common knotweed (*Polygonum aviculare*).

Photo: © 2011 J.C. Jones, bugguide.net



DAMSEL BUG

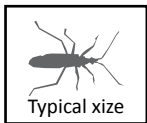
Nabis spp. (order Hemiptera)



Benefits: Both nymphs and adults prey on aphids, leafhoppers, thrips, and small caterpillars.

Attract & maintain: Anything in the sunflower family, as well as goldenrod, yarrow, and alfalfa.

Photo: © 2014 Justin Cret, bugguide.net



GROUND BEETLE

Family *Carabidae* spp. (order *Coleoptera*)

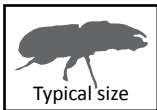


Identification: Mostly black or brown, often with prominent jaws. There are hundreds of species. Most hide under cover during the day.

Benefits: Prey on slugs, snails, cutworms, and other pests on or beneath the soil surface.

Attract & maintain: Permanent plantings, amaranth, white clover in orchards, mulching.

Photo: D. Cappaert, Michigan State Univ, Bugwood.org



MINUTE PIRATE BUG

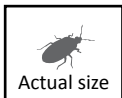
Orius tristicolor (Family *Anthicoridae*, order *Hemiptera*)



Benefits: Both nymphs and adults prey on aphids, thrips, whiteflies, spider mites, small caterpillars, leafhoppers, and insect eggs.

Attract & maintain: Carrot family (e.g. Queen Anne's lace, tansy, coriander, bishop's weed, and chervil), sunflower family (e.g. cosmos, goldenrod, daisies, yarrow), baby-blue-eyes (*Nemophila*), hairy vetch, alfalfa, corn, crimson clover, buckwheat, blue elderberry (*Sambucus caerulea*) willows, and shrubs. Maintain permanent plantings or hedgerows.

Photo: © 2011 Mike Quinn, bugguide.net



WESTERN PREDATORY MITE

Phytoseiidae spp. (order *Arachnidae*)



Identification: Very small tan to reddish-brown mites. The nymphs are similar to the adults.

Benefits: Prey on spider mites, thrips, and other types of mites.

Attract & maintain: Avoid use of insecticides. Provide non-crop habitat for prey species.

Photo: © 2008 Ashley Bradford, bugguide.net



Resources for Texas Growers

ATTRA website: Over 400 publications on all aspects of sustainable and organic farming and marketing, along with searchable directories, how-to videos, webinars, and many other resources, mostly free. attra.ncat.org

ATTRA information service: Free technical assistance in English or Spanish. Phone 800-346-9140 (English) or 800-411-3222 (Spanish). Send a text to askanag@ncat.org. Or use the e-mail form at attra.ncat.org/ask.php.

ATTRA Ecological Pest Management Database: Searchable directory of environmentally friendly pest control products. Allows you to search by pest, active ingredient, or trade name. www.attra.ncat.org/pest.html.

OMRI directories: From the Organic Materials Review Institute: Search over 3,000 products that are "OMRI Listed®" to U.S. National Organic Program standards. Or check 900+ materials to learn their status in organic production. www.omri.org/omri-lists

Texas IPM Program website: A one-stop source from Texas A&M University, offering photos, directories, articles, and news. <http://ipm.tamu.edu>

e-Organic website: Large collection of organic farming articles, publications, and links from university extension programs around the country, including many pest management resources. <http://eorganic.info>

Texas Organic Farmers & Gardeners' Association: Grassroots member-based organization connecting and serving Texas organic farmers and gardeners. Offers a newsletter and annual conference. www.tofga.org

Especially for Rio Grande Valley growers

SOAR Partnership, University of Texas-Pan American: Researching local challenges faced by organic farmers in South Texas and giving UTPA students real-world experience in agricultural research. Contact Dr. Alex Racelis (racelisa@utpa.edu) or Dr. Carlo Moreno (morencr@utpa.edu).

NCAT Southwest Office, San Antonio: Free technical assistance with any aspect of sustainable agriculture. Phone 210-265-3905. Or contact Robert Maggiani (robertm@ncat.org) or Mike Morris (mikem@ncat.org).

Texas A&M AgriLife Extension Center–District 12: 2401 E. Highway 83 Business, Weslaco, TX 78795 Expert help with insect identification and IPM control strategies. Contact Extension Entomologist Raul Villanueva: rtvillanueva@ag.tamu.edu or (956) 969-5604. Or former District 12 IPM Coordinator Juan Anciso: j-anciso@tamu.edu or 956-968-5581.

Earthwise Organics, Inc.: 900 West Van Buren Avenue, Harlingen, Texas. Phone 956-207-0500 or e-mail office@earthwiseagriculture.net. Website: earthwiseagriculture.net. Contact Thomas Harr. *Supplying farmers, gardeners, and landscapers with sustainable and/or organic products and services to meet agricultural or horticultural needs, both large and small.*

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