



Peach Twig Borer (*Anarsia lineatella*)

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Do You Know?

- Peach twig borer is a major pest of peach, nectarine and apricot in Utah.
- There are multiple generations each year.
- Spring and early summer generations of larvae bore into and kill new shoots while later summer larvae attack fruit, typically entering fruit near the stem end.
- Use of pheromone traps and a degree-day model are critical for timing controls targeting summer generations.
- Insecticide application is the primary control; there are effective, low toxicity insecticide options.



Fig. 1. Young peach twig borer larva on peach



Fig. 2 Shoot strike damage caused by overwintered larvae

Peach twig borer (*Anarsia lineatella*) is found worldwide wherever stone fruits are grown. In Utah, it is a significant pest on peach, nectarine, and apricot. There are typically three generations of peach twig borer in northern Utah (May-June, July, and August-September) and four or more in southern Utah. Young larvae (Fig. 1) that have overwintered emerge from protected shelters on limbs and twigs during bloom to petal-fall and burrow into developing shoots (Fig. 2). When populations are high, spring larval feeding can cause substantial damage to trees. The first adults are usually detected during April in southern Utah and May in northern Utah. Economic yield loss occurs during the summer when larvae of subsequent generations attack the fruit (Fig. 3). Insecticides are currently the most effective control tactic. Lower toxicity insecticides such as microbial products (*Bacillus thuringiensis* and spinosad) and insect growth regulators (methoxyfenozide, diflubenzuron, and others) can provide excellent control when timed with early larval feeding and egg hatch.

HOSTS

peach, apricot, nectarine,
almond, plum, prune

LIFE HISTORY

Larva—Overwintering Stage

- **Where:** Found in cracks, crevices, and limb crotches of two- and three-year-old wood. First and second instar larvae overwinter in silken cells called hibernacula. (Hibernacula are small chimneys of the larva's silk embedded with frass and wood chips.)
- **When:** Larvae emerge in the spring (bloom to petal fall) and crawl to developing buds and terminals, where they feed inside the shoot (Fig. 2) and then exit and move on to feed on several more shoots until they complete their development.
- Mature larvae of the overwintering generation pupate in protected sites on the trunk and branches.



Fig. 3. Damage to fruit caused by peach twig borer larvae



Fig. 4. Adult male peach twig borer moth

Pupa

- **Where:** Located in cracks and crevices of bark on limbs and trunk.
- **Color:** Pupae are smooth, brown; without a cocoon.
- The pupae from overwintering larvae may take as long as 30 days to mature because of cool spring temperatures, while the pupation stage in summer generations is 7 - 11 days.

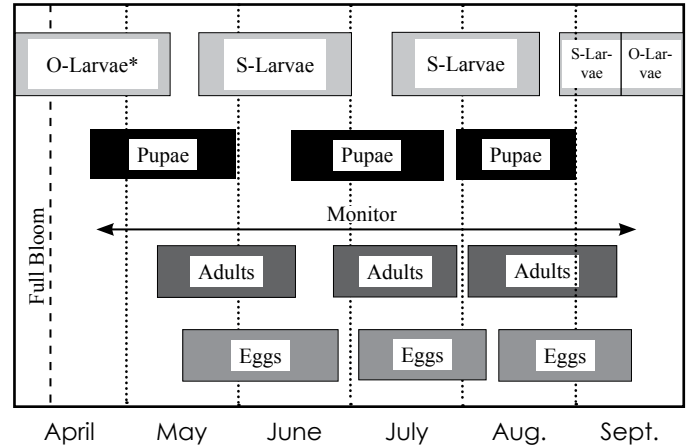
Adult—Monitoring Stage

- **Size and Color:** Moths are small, 0.3 – 0.5 inches long, with light and dark gray mottled wings. Scales on the front of the head cause the head to appear pointed (Fig. 4).
- **When:** Adults of the overwintering generation emerge beginning in mid-May in northern Utah (April in southern Utah) (Fig. 5). Males and females use wing beat acoustic signals in addition to sex pheromones to locate each other for mating.
- Each mated female can lay 80 - 90 eggs.

Egg

- **Where:** Eggs are deposited singly on young, tender shoots, on the underside of leaves, and on developing fruit beginning about the time of shuck fall.
- **Color:** Eggs are yellowish white to orange, oval shaped, and heavily sculptured.
- Hatch occurs in 4 - 18 days depending on temperature.

Figure 5. Life history of peach twig borer in northern Utah. There are three generations per year and the insects spend the winter as young larvae.



The arrow indicates when adults should be monitored with pheromone traps. *O=Overwintering; S=Summer

Larva—Damaging Stage

- **Where:** First generation larvae feed in the terminal shoots while summer generations attack the fruit.
- **Color and Size:** Young larvae are pale with light brown rings and black heads (Fig. 1). Older larvae have a dark brown head and prothorax (segment just behind the head) and chocolate brown body. The area between body segments is lighter in color giving larvae a distinctive striped appearance (Fig. 6). Mature larvae are about 0.5 inch long.
- Larvae mature and pupate in 2-3 weeks.
- When summer generation eggs hatch, these larvae generally enter fruit to complete their development, then emerge, pupate, and become the next generation of adults (Fig. 5).

HOST INJURY

Peach twig borer larvae are primarily attracted to new shoot growth and secondarily to maturing stone fruits. Larvae of early generations feed inside terminal shoots, causing the leaves to wilt and eventually kill the terminals. These dead shoots are referred to as "shoot strikes" (Fig. 2). On young trees, repeated death of terminal branches causes stunted growth and reduced tree vigor.

As fruit pits harden (as fruit develops color), the fruits become more appealing to larvae. Larvae enter primarily through the stem (Fig. 3) end and feed just under the skin or next to the pit, especially if the pit splits open (Fig. 6). Larvae will also enter where fruit touches another fruit, leaves, or a branch. After larvae complete development inside fruit, small exit holes, often with sticky sap protruding, may be visible. Earwigs are attracted to and enter fruit with split pits and tunnels created by twig borer larvae. Chewed fruit is unfit for sale and is predisposed to micro-organisms that cause rotting.



Fig. 6. Interior peach injury caused by borer feeding

TIMING CONTROL: DEGREE DAY MODEL

Insect development is temperature-dependent, so phenological events such as moth flight, egg laying, and larval development can be predicted based on accumulated heat over time, called degree days (DD). A degree day model for specific phenological events has been developed for many orchard insects, including peach twig borer. Like codling moth, peach twig borer development occurs between the lower and upper temperature thresholds of 50° F and 88° F. The degree day model is used to more accurately time and reduce the number of insecticide applications.

In order for the model to work, one must first know the date of consistent moth flight, called **biofix**. Biofix is a biological marking point from which an insect's development is measured for the remainder of the season. When biofix is determined, the insect model begins at 0 degree days. Biofix is determined using pheromone traps.

Large delta (Fig. 7) or wing style pheromone traps are available for purchase to monitor adult activity. Sex pheromone lures are sold separately and when placed inside the traps dispense the female sex pheromone that is attractive to males only. A sticky surface inside the trap collects the moths (Fig. 4). Lures are available in a 30-day or 60-day formulation.



Fig. 7. Plastic delta trap with pheromone lure inside

Determining Degree Days

To know when to hang pheromone traps, start recording degree days March 1 in northern Utah or January 1 in southern Utah by:

1. Collecting representative daily maximum and minimum air temperatures and using the DD look-up table (Table 1), or
2. Obtaining the information provided by USU Extension on the IPM Pest Advisories Web page (<http://utahpests.usu.edu/ipm/html/advisories>) or from your county extension office.

Trap Placement

- Assemble trap with pheromone lure. Store unused lures in a freezer. To prevent contamination, do not handle or store unsealed pheromone lures together for more than one insect species, and do not reuse a trap that contained a pheromone lure from another species. Latex gloves or forceps can be used to handle lures to prevent cross-contamination.
- Place traps in orchards by early May (early April in southern Utah) or based on degree-day (temperature) accumulations (300 DDs for northern Utah, Table 1). The first moths are expected by 400 – 450 DD.

- Hang traps within the upper third of the tree canopy (preferably 6-7 ft high) making sure the trap entrance is not blocked and that it is parallel to the prevailing wind direction (Fig. 8).

- A minimum of two traps should be placed in each orchard. For orchards greater than 10 acres, place one trap for every 5 acres.

- Hang at least one trap near the edge and one near the center of each stone fruit orchard to determine if moths are immigrating from outside sources and/or overwintering within the orchard. Suspected "hot spots" within the orchard should be monitored separately.

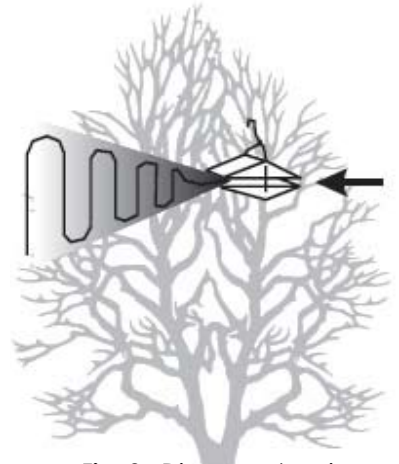


Fig. 8. Diagram showing trap hung parallel to prevailing wind.

Trap Servicing

- Check traps every 1-2 days until more than two moths are trapped on two or more consecutive nights (biofix). When determining biofix, note that zero trap captures do not necessarily mean there are no moths in the orchard. Evening temperatures below 60° F are not conducive to moth flight, and a lack of wind in the evening may prevent emission of a pheromone plume from the trap, thus no moths are lured inside (Fig. 8). Also, old or ineffective lures can cause zero trap catch.

Table 1. Degree Day Look-Up for Peach Twig Borer*

Lower threshold: 50° F Upper threshold: 88° F

| | | Minimum Temperature | | | | | | | | | | | | | | | | | | | | | | |
|---------------------|----|---------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| | | 15 | 18 | 21 | 24 | 27 | 30 | 33 | 36 | 39 | 42 | 45 | 48 | 51 | 54 | 57 | 60 | 63 | 66 | 69 | 72 | 75 | 78 | 81 |
| Maximum Temperature | 51 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | | | | | | |
| | 54 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | | | | | | | | | | | |
| | 57 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 4 | 5 | | | | | | | | | |
| | 60 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 6 | 7 | 9 | | | | | | | | |
| | 63 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 6 | 8 | 9 | 11 | 12 | | | | | | | |
| | 66 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 6 | 6 | 7 | 7 | 9 | 10 | 12 | 13 | 15 | | | | | | |
| | 69 | 5 | 5 | 5 | 5 | 6 | 6 | 6 | 7 | 7 | 7 | 8 | 9 | 11 | 12 | 14 | 15 | 17 | 18 | | | | | |
| | 72 | 6 | 6 | 7 | 7 | 7 | 7 | 8 | 8 | 8 | 9 | 10 | 10 | 12 | 13 | 15 | 16 | 18 | 19 | 21 | | | | |
| | 75 | 8 | 8 | 8 | 8 | 8 | 8 | 9 | 9 | 10 | 10 | 11 | 12 | 14 | 15 | 17 | 18 | 20 | 21 | 23 | 24 | | | |
| | 78 | 9 | 9 | 9 | 9 | 10 | 10 | 10 | 11 | 11 | 12 | 13 | 13 | 15 | 16 | 18 | 19 | 21 | 22 | 24 | 25 | 27 | | |
| | 81 | 10 | 10 | 10 | 10 | 11 | 11 | 12 | 12 | 13 | 13 | 14 | 15 | 17 | 18 | 20 | 21 | 23 | 24 | 26 | 27 | 29 | 30 | |
| | 84 | 11 | 11 | 11 | 12 | 12 | 12 | 13 | 13 | 14 | 15 | 16 | 16 | 18 | 19 | 21 | 22 | 24 | 25 | 27 | 28 | 30 | 31 | 33 |
| | 87 | 12 | 12 | 13 | 13 | 13 | 14 | 14 | 15 | 16 | 16 | 17 | 18 | 20 | 21 | 23 | 24 | 26 | 27 | 29 | 30 | 32 | 33 | 35 |
| | 90 | 13 | 14 | 14 | 14 | 15 | 15 | 16 | 16 | 17 | 17 | 18 | 19 | 21 | 22 | 24 | 25 | 27 | 28 | 30 | 31 | 33 | 34 | 35 |
| | 93 | 14 | 14 | 15 | 15 | 16 | 16 | 17 | 17 | 18 | 18 | 19 | 20 | 22 | 23 | 25 | 26 | 28 | 29 | 30 | 31 | 33 | 34 | 36 |
| | 96 | 15 | 15 | 15 | 16 | 16 | 17 | 17 | 18 | 19 | 19 | 20 | 21 | 23 | 23 | 25 | 26 | 28 | 29 | 31 | 32 | 34 | 35 | 36 |
| | 99 | 16 | 16 | 16 | 16 | 17 | 17 | 18 | 18 | 19 | 20 | 21 | 21 | 23 | 24 | 26 | 27 | 29 | 30 | 31 | 32 | 34 | 35 | 36 |
| 102 | 16 | 16 | 17 | 17 | 18 | 18 | 19 | 19 | 20 | 20 | 21 | 22 | 24 | 25 | 27 | 27 | 29 | 30 | 32 | 33 | 34 | 35 | 36 | |
| 105 | 17 | 17 | 17 | 18 | 18 | 18 | 19 | 20 | 20 | 21 | 22 | 23 | 24 | 25 | 27 | 28 | 30 | 30 | 32 | 33 | 35 | 35 | 36 | |
| 108 | 17 | 17 | 18 | 18 | 19 | 19 | 20 | 20 | 21 | 21 | 22 | 23 | 25 | 26 | 27 | 28 | 30 | 31 | 32 | 33 | 35 | 35 | 36 | |
| 111 | 18 | 18 | 18 | 19 | 19 | 20 | 20 | 21 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 29 | 30 | 31 | 32 | 34 | 35 | 36 | 37 | |
| 114 | 18 | 18 | 19 | 19 | 20 | 20 | 21 | 21 | 22 | 22 | 23 | 24 | 25 | 26 | 28 | 29 | 30 | 31 | 33 | 34 | 35 | 36 | 37 | |

To find the total degree days for a day, locate the low and high temperatures and follow the rows to where they intersect. For temperatures between those listed, use the nearest shown.

*Adapted from: Beers, E.H, J. F. Brunner, M. J. Willett, and G. M. Warner. 1993. **Orchard Pest Management: A Resource Book for the Pacific Northwest.** Good Fruit Grower. 276 pp.

- Once biofix has occurred, accumulated DD are reset to zero (Table 2).
- After biofix, check traps weekly. Record the number of moths caught (see Peach Twig Borer Sampling Form, ENT-36SF-06). After recording, remove moths from trap.
- Change pheromone caps according to manufacturer's recommendations (every 30 or 60 days depending on lure type), and change trap bottoms after catching 40 - 50 moths or after dust and debris have collected on the sticky surface.
- Plan to use the same type of trap and lure from year to year so that you can compare results.
- Save the sampling forms from each orchard, each season. This information can be used to monitor moth emergence, to start degree-day accumulations, to assist with determining optimal spray timings, to determine the relative size of the moth population, to help in evaluating the success of your control program, and to make comparisons across years.

Table 2. Major events in a peach twig borer management program, based on accumulated degree days

| Degree Days | % Adult Emergence | % Egg Hatch | Management Event |
|--|------------------------|-------------|--|
| 300 | 0 | 0 | • Place traps in orchards |
| 400-450 | First moths expected | 0 | • Check traps every 1-2 days until biofix is determined |
| First Summer Generation | | | |
| 0 (biofix) [†] | First consistent catch | 0 | • Reset degree days to 0 |
| 300-400 | 76-94 | 5-28 | • Time first summer generation spray so that it is applied by this time |
| Second Summer Generation | | | |
| 1200-1360 or 300-400 after 2nd gen. biofix | 46-81 | 5-28 | • Time second summer generation spray so that it is applied by this time |
| Third Generation | | | |
| 2140-2340 or 300-400 after 2nd gen. biofix | 37-74 | 5-29 | • Time third summer generation spray so that it is applied by this time |

*Begin accumulating degree days after daily temperatures begin to exceed 50° F, typically on January 1 for southern Utah or March 1 for northern Utah.

† Biofix is when at least two moths are caught on two or more consecutive nights.

large overwintering population, then applying the first summer spray earlier, by 220 DD after biofix will target 1% egg hatch.

- In most orchards, control of second and third summer generations will be necessary. Time cover sprays for 1200-1360 and 2140-2340 DDs after biofix for second and third summer generations, respectively (Table 2).
- An alternative method for timing sprays beyond the first summer generation is to reset a biofix for subsequent moth flights. This method has proven useful in southern Utah where four full generations of peach twig borer have been documented. Setting new biofixes can be difficult if moth flight does not subside between generations (usually because moth densities are very high). If biofixes for subsequent generations can be distinguished, then applying sprays by 300-400 DD after each new biofix can provide a more accurate timing for early egg hatch (Table 2).

MANAGEMENT

Insecticides

Treatments at the delayed dormant timing and/or during bloom are critical for reducing the severity of summer generations (Tables 2 and 3). Good coverage is important because larvae are killed after consuming insecticide residues as they tunnel in shoot twigs.

Rotate among insecticide classes (see list of insecticides on page 6) to prevent development of resistance to insecticides in the peach twig borer population. Refer to Table 3 for recommended application timings for insecticide types.

Timing Insecticide Sprays

Studies conducted in northern Utah confirm that timing summer sprays with the degree-day model (described above) can be very effective. When the efficacy of two summer sprays timed with the model as compared with that of three sprays (beginning on 200 DDs after biofix and then repeated in 21-day intervals), there was no difference (no fruit were damaged).

- The first sprays may be applied during the delayed dormant period when buds swell and show the first indication of color and/or from pink through bloom if using low toxicity insecticides that are not harmful to pollinators. Overwintering larvae cause damage when they emerge and burrow into developing shoots.
- The first summer cover spray should be applied from 300-400 DDs after biofix (Table 2). This timing will target 5-28% larval emergence from eggs of the first summer generation, provide optimum control of larvae, and suppress adult populations. Sprays applied too early may require additional applications, while sprays applied too late may not prevent earlier shoot and fruit injury.
- If early season shoot strikes were severe, indicating a

Table 3. Cover Spray Timing and Recommendations:

| Phenological Event | Timing/Target | Examples |
|---------------------------|--|--|
| Calyx green to first pink | Overwintering larvae | Dormant oil plus IGR, synthetic pyrethroid, organochlorine, organophosphate, or carbamate insecticide |
| Pink to Petal Fall | Overwintering larvae feeding on young shoots | <i>Bacillus thuringiensis</i> , spinosad, or IGR (repeat 5-7 days apart) synthetic pyrethroid (wait until petal fall; toxic to pollinators) |
| Summer Sprays | Hatching larvae and adults | IGR, microbial, organophosphate, organochlorine, carbamate*, or synthetic pyrethroid* insecticide |

*Caution: Synthetic pyrethroids and carbamates can cause spider mite populations to flare during hot weather by killing predaceous mites, so summer treatments should be avoided.

Carbamates

- carbaryl (Sevin)* - if near harvest (1 day PHI)

Insect Growth Regulators

- diflubenzuron (Dimilin) – not after petal-fall
- pyriproxyfen (Esteem)
- methoxyfenozide (Intrepid) – not registered for apricot
- tebufenozide (Confirm)

Microbials

- *Bacillus thuringiensis* var. *kurstaki* (Dipel*, Thuricide)
- spinosad (Green Light*, Entrust, Success)

Organochlorines

- endosulfan (Thionex, Phaser)

Organophosphates

- chlorpyrifos (Lorsban) – dormant or bark treatment only; (not registered on apricot)
- malathion (Malathion*)
- methidathion (Supracide) – dormant or bark treatment only
- phosmet (Imidan)

Synthetic Pyrethroids

- cyhalothrin (Proaxis, Warrior)
- esfenvalerate (Asana, Onslaught, Ortho Bug-B-Gon*)
- deltamethrin (Battalion)
- gamma-cyhalothrin (Proaxis)
- lambda-cyhalothrin (Silencer, Warrior)
- permethrin (Ambush, Astro, Pounce, Bayer Advanced Complete*) – use on peaches only

Other

- horticultural mineral oil (Orchex, Sunspray, Volck)*
- kaolin clay (Surround*)

All brand names are registered trademarks. Examples of brands may not be all-inclusive, but are meant to provide examples of effective insecticides registered on apricot, nectarine, and peach in Utah. The availability of insecticides is changing rapidly. Always check the label for registered uses, application and safety information, and protection and pre-harvest intervals.

*Insecticide products that may also be available for use on home fruit trees.

Mating Disruption

Mating disruption (MD) is a technique that uses pheromone dispensers that permeate the air in an orchard and make it difficult for males to find females. The idea is to disrupt mating and reduce the insect population. Several reasons, however, have limited the success of MD for twig borer. New research shows that males use acoustic signals (wing beat frequency of female moths) as important mate-finding cues. In addition, the product is not long-lived enough to protect multiple summer generations, and the re-application timing is critical. Other factors such as orchard size, proximity to outside insect pressures, dispenser placement, and application rate also can influence the use of MD.

- Some Utah growers have used it to control first generation larvae, when dispensers are hung just before first moth flight.
- MD may be an option for organic growers when used in combination with organically approved insecticides such as *Bacillus thuringiensis*, spinosad, kaolin clay, horticultural oil, or others.

Biological Control

There are numerous natural enemies that will suppress peach twig borer populations. In California, several parasitic wasps (Family Chalcididae) and ants (*Formica* spp.) have destroyed a significant portion of larvae in some years.

Cultural Controls

Prune out shoot strikes in the late spring and early summer as soon as they are detected to prevent these larvae from completing development and contributing to summer generations of the pest. If old shoot strikes are observed during pruning in late winter to early spring, plan to apply early season controls. Old strikes hold onto the dead leaves and appear as "flagged" terminals.

All images courtesy of Shawn Steffan, USU Extension

Precautionary Statement: All pesticides have benefits and risks, however following the label will maximize the benefits and reduce risks. Pay attention to the directions for use and follow precautionary statements. Pesticide labels are considered legal documents containing instructions and limitations. Inconsistent use of the product or disregarding the label is a violation of both federal and state laws. The pesticide applicator is legally responsible for proper use.

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