TRÉCÉ INCORPORATED

The IPM Partner® Insect Monitoring Guidelines Book

A practical guide to more effective insect pest monitoring

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Trécé Incorporated

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WARNING

Treatment thresholds are based only on the trap/lure designs and use patterns recommended herein. Variations may lead to severe consequences. Please check with Trécé or local authorities before initiating changes to the published thresholds.

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And the Company Behind It.

What You Have In Your Hands. And Why.

This book is a tool. We wanted to put into one place a collection of data on the most common pests that are infesting tree and vine as well as row crops — and then put that information into the hands of our key customers and key contributors to IPM. The information has been sourced from personnel and publications of various universities, extension services and government research agencies. It is the most updated material available on the subject — and the first time that the material has been put together in so simple and practical a form, to our knowledge.

And knowledge is what The IPM Partner® Book is really all about. Indeed, it is at the heart of all that we do at Trécé. Every one of our monitoring products is designed to impart knowledge that can be practically applied to solve a problem. Every encounter with a customer, a PCA, a grower or academician will hopefully help us gain knowledge about something we didn't know before. Every research and development dollar is a practical investment in the acquisition of knowledge that hopefully will translate into products and services that will give you a critical edge — on the pests you need to control and a clock you can only hope to contain.

Our philosophy is principally responsible for Trécé being the number one manufacturer and marketer of pest monitoring systems in the world. It has worked for us because it has worked for our clients. Quite simply, people look to us for integrated pest monitoring solutions because we know our business better than anyone in the business.

Trécé Research And Development: Keeping A Razor Sharp Edge.

If knowledge is Trécé's core value in the marketplace, continuing research and development is our core resource. The company has, from the beginning, invested heavily in R&D, hiring the finest professionals and using state-of-the-art facilities and equipment. We are committed to always giving you the edge by always being on the leading edge ourselves. Trécé works closely with government agencies, universities and our business associates throughout the world to continuously refine and advance the technology of effective monitoring systems.

In the field and in the laboratory, Trécé trials have been focusing on improvements to our controlled-release technology. Considerable efforts are also being expended

both domestically and internationally to create a companion line of insect control products to compliment the pheromone-based monitoring and detection systems.

Manufacturing: The Dynamics Of Quality And Quantity.

Much of the research and development effort over the years has gone into the creation

of sophisticated manufacturing facilities and equipment at our Salinas headquarters. We make what we market at Trécé because, through planning, consistency, flexibility and rigorous quality control, we feel we can simply do a better job. Our own chemists manage all of the pheromone formulations. Our own engineers create sophisticated equipment such as our high-speed, surface glue-coaters, and manage all of the system design and technical issues. And our own professional staff manages and executes a tightly integrated manufacturing process that optimizes quality, production utilization, speed and flexibility. Trécé's ability to expand and contract production from small custom orders to three-shift production runs is critical to our success.

Pherocon® And Storgard®. The Monitoring Standard For Over Two Decades.

The Trécé product catalog currently contains over 100 species-specific, pheromone-based attractants and lures, and a full line of trap models designed for a wide variety of flying and crawling insect pests that attack crops and stored crops. These products are marketed under two internationally respected names, Pherocon® and Storgard®.

The Pherocon® line provides pest managers, farmers and agricultural consultants with an early-warning system to detect adult insect emergence and monitor pest populations so that timely control programs can be implemented. In the 1970s, Pherocon® products were utilized in early integrated pest management research and eventually became the world standard for effective monitoring. Today, these products are also used to track the migration of pests into non-infested areas. Beyond detection and monitoring, phenology models for many significant insects have been developed using Pherocon® products to establish biofix points. And economic thresholds based on Pherocon® trap counts have been created for several insects. Taken together, these capabilities deliver a turnkey solution for optimizing treatment times — a solution the competition, without our history, research and knowledge, simply cannot deliver.

The Storgard® product line provides early-warning detection of potentially damaging insect infestations during processing, transport, warehousing and marketing of foods and other commodities. Proper use of these products can reduce product losses, increase the quality of stored foods and save time and money. Storgard® has been the industry standard for more than a decade. Unlike light traps, Storgard® products are more species specific and more sensitive to low populations, invaluable features to quality assurance managers who need to meet zero tolerance requirements in milling, baking and other food processing and storage facilities.

In addition to the Pherocon® and Storgard® lines, Trécé also offers several specialty products, including a unique Japanese beetle trapping system with a permanent catch basin. Rugged, all plastic construction sets this trap apart from "bag-type" alternatives that are less effective and shorter-lived.

Knowing Our Business Means Knowing Our Customers.

It means knowing the kind of quality they demand, the kind of timelines they run on, the kind of service and support they need. We have built an unprecedented level of loyalty by delivering on a number of critical factors: our adherence to the strictest quality assurance programs, our history of consistent reliability over two decades; and our worldwide distribution network and sophisticated international shipping and service capability.

Knowing What To Do Next.

Someone once said: "Wisdom is oft times simply knowing what to do next." Those words may well put our business in the best perspective. Certainly, Trécé products help our customers know what to do next by giving them knowledge of exactly when to implement control programs. Trécé management knows that what they must always do next is more research, more development, more consulting with leading experts, agricultural advisors and customers in the field. Maybe what you ought to do next is give Trécé a call.

You Deserve An Edge.

Your Edge—And Ours—Is Knowledge.

A Practical Approach Featuring Codling Moth

Introduction.

Used in conjunction with pheromone traps and other monitoring techniques, PHENOLOGY or degree-day models are valuable tools for improving insect control decisions for codling moth, Oriental fruit moth, and other important insect pests. Uses include insect detection, determining optimum timing for pesticide applications, pinpointing generation developments/events and, in some areas, treatment thresholds.

Phenology Models/Degree-Days.

The growth rate of organisms is related to temperature. In general, the higher the temperature, the faster the organism develops. Models utilizing accumulated degree-days to predict phenology events have been developed for codling moth and many other important agricultural pests (see Table 1).

Codling Moth Phenology (Table 1)

Life Stage	*Average D° F*	*Average D° C*
Preovoposition Period	58	32.2
Egg Hatch Begins	158	87.7
Larval Development	471	261.4
Pupal Development	431	239.2
Generation time	1060	588.3
(Threshold temps: 50 and 88° F or 10 and 31.1° C)		

Degree-Day Thresholds.

Generally, lower and upper thresholds are estimated using laboratory studies to determine growth rates under different constant temperatures. The number of heat units is estimated for different stages of growth during a generation. From such studies, phenology models can be constructed. Thresholds and the number of heat units are species-specific.

Degree-Day Defined.

Heat units are generally expressed as degree-days. By definition, a degree-day is expressed as one degree above the lower threshold for a 24-hour period. For example, if we have an insect with a lower developmental threshold of 50° F or 10° C, a constant temperature for a 24-hour period of 59° F or 15° C would yield of 9 degree-days (D°) F or 5 D° C, or a constant temperature of 68° F or 20° C would yield 18 D° F or 10 D° C.

Phenology models are based on the assumption that below a critical temperature insects grow little if any. The lowest temperature at which growth ceases is known as the lowest developmental threshold temperature. Once temperatures exceed the lower threshold, as temperatures increase the rate of development increases until it becomes so hot that the insect dies. However, in many insects there is a point before thermal death at which the rate of development does not increase further and remains constant. This is known as the upper-threshold temperature.

Estimating Degree-Days/Averaging Method.

In nature, of course, temperatures are not constant so different methods of estimating degree-days have been developed. The basic method is known as averaging. This is based on the following formula:

$$\frac{(\text{High Temperature} + \text{Low Temperature}) - \text{Lower Threshold}}{2}$$

This formula gives an accurate estimate of degree-days as long as the daily temperature does not go below the lower threshold or above the upper developmental threshold. However, in cooler or warmer climates this formula will generally under-estimate the number of degree-days.

Estimating Degree-Days/Triangulation Method

A more complicated, although more accurate, method of calculating degree-days is called the triangulation method. Formulas covering all possible situations are available and easy to use, especially if a programmable calculator is available. Because of space limitations, formulas will not be presented here but are available from research and extension offices.

Estimating Degree-Days/Sine-Curve Method.

If a computer is available, there is a method of estimating degree-days using a sine curve. This technique uses a day's low and high temperatures to produce a sine curve over a 24-hour period. Then it estimates degree-days for that day by calculating the area above the threshold and below the curve.

Another way to estimate degree-days is to use precalculated tables (see Pages 27 - 28) with the low for the day charted across the top and the high down the side. Such tables can be constructed using any suitable degree-day calculation method. To find the degree-days accumulated for a day, the user simply locates the appropriate high and low temperatures and follows the column and row until the two intersect. Different tables must be used for species having different thresholds.

Other methods of calculating degree-days using hourly temperatures or temperature measurements taken at other times are available. However, degree-day figures in this pamphlet are based on using daily maximum/minimum temperatures as discussed above.

Instruments for Measuring Temperatures.

The simplest instrument for calculating degree-days is a maximum/minimum thermometer. Reading this instrument and correlating to a precalculated table is a very useful and accurate degree-day accumulation technique. Be certain to keep records accurately.

Other relatively inexpensive instruments are available which automatically monitor temperatures and calculate degree-days for each day. Degree-days are then accumulated and stored and can be accessed as needed by simply pushing the correct button.

Weather Shelter

All temperature monitoring devices, whether maximum/minimum thermometers or automatic devices, should be housed in a suitable weather shelter or radiation shield to assure accuracy. Since temperatures can vary greatly over relatively short distances, temperature monitoring stations should be as close as practical to orchards where data is being used. The further away from a monitoring site that temperatures are collected, the less accurate degree-day estimations will be.

Bio-fix

Bio-fix is the point when pheromone traps indicate that a sustained flight has started. This is the most useful point to begin accumulating degree-days. And, most degree-day models use this approach.

Codling Moth Threshold

For codling moth, degree-days should be calculated using a lower threshold of 50° F or 10° C and upper threshold of 88° F or 31° C. Codling moth events based on degree-days are as follows:

Codling Moth

Phenology/Degree-Days (Table 2)

D° F	*D° C*	*% of Moth Flight*	*% Egg Hatch*
79	44	10	___
169	94	25	––
250	139	50	2
386	214	75	25
478	265	___	50
595	330	___	75
733	407	100	90

Codling Moth Treatment Recommendations

Insecticide applications for codling moth should be aimed at killing newly-hatched larvae before they enter fruit. Research in the western United States indicates that the first treatment of the overwintered generation should be applied after 250 D° F or 139 D° C have accumulated. This corresponds to about 2% egg hatch.

Continue monitoring pheromone traps and, if trap catches exceed the treatment threshold, a second treatment should be made in 2 to 3 weeks, after residue from previous treatment is no longer effective. Still a third treatment in 2 to 3 weeks may be necessary for the overwintered generation if population levels are exceptionally high.

The second and subsequent generations should begin after about 1038 D° F or 576 D° C. Reset the degree-day accumulator to 0 at the beginning of each generation and follow guidelines for the first generation treatments as long as trap counts exceed treatment thresholds.

Other Insects

Other possible pests include Oriental fruit moth (OFM), with a lower threshold of 45° F or 7.2° C and upper threshold of 90° F or 32.2° C; San Jose scale, with a lower threshold of 51° F or 10.5° C and upper threshold 90° F or 32.2° C.

Using Pheromone Traps

It is critical that growers and decision makers understand that many factors can impact pheromone trap catches and the number of degree-days accumulated. The trap design, number of traps, type glue surface, how the traps are put together, trap placement both within the orchard and in the tree, trap maintenance, and the type of lure and how often it is changed, can all dramatically impact the number of moths caught.

The Pherocon® 1CP or Pherocon® II traps should be used for codling moth. The Pherocon® 1CP trap should be put together so that the slotted bottom openings in the liner are the only places moths can enter the trap.

The Pherocon® 1CP trap should be placed inside the tree canopy. Trécé recommends that traps should be placed 6 - 8 feet or 1.8 - 2.4 meters high within the tree canopy for conventional monitoring. Usually, the higher in the canopy the trap is placed, the more moths will be caught. TRAPS PLACED ABOVE OR BELOW THE CANOPY WILL CATCH FEW, IF ANY, CODLING MOTH.

The Pherocon® 1CP traps should be placed throughout orchards at the rate of 2.5 acres or 1 per hectare for codling moth. Traps placed on "border" or perimeter trees will often trap males from adjoining orchards or abandoned trees and are a good way to detect sources of moths, but will often over-estimate the problems within a particular orchard. Remember, pheromone traps catch only males. High counts in border traps may or may not indicate high female pressure. The best estimate of a population within an orchard can be made using traps within the orchard away from the border. False readings of border traps can be minimized by hanging traps at least 33 yards or 30 meters from the edge of the orchard.

Traps should be checked at least twice weekly until bio-fix and then at least weekly throughout the season. Moths should be counted and recorded each time traps are checked and the adhesive on the liner (adhesive-coated bottom) stirred each time. Liners should be changed after trapping a minimum of 50 moths or when dirty. Pherocon® standard red septa for codling moth should be changed monthly and Pherocon® L2™ septa every 8 weeks.

Packages containing standard Pherocon® red septa should be opened the night before to prevent a "spike" the first night.

Store lures in a refrigerator or freezer until ready to use. When transporting lures to fields, do not place them in the sun or on the dashboard or seat of a vehicle. Extremely hot temperatures will harm the lures.

Lures being replaced should be removed from the trap and carried out of the field so they will not interfere with trap catch.

IPM Partner Guidelines: TREE AND VINE INSECTS

Description:

Adults:

Female scale remain beneath a circular, gray to reddish-tan cover which is firmly attached to wood, fruit, or leaves. Females molt twice from the crawler stage to maturity. Males molt four times. At maturity, the adult male emerges as a tiny, yellow to light reddish-brown, two-winged insect with long, thread-like antennae, and a distinct dark band across its back.

Crawler Stage:

The female California red scale gives birth to live young which, after emerging from beneath the female scale's cover, crawl to seek suitable resting sites. The pin-head sized crawlers are round and yellow.

White Cap Stage:

Once the crawlers settle and begin to feed they secrete white cottony filaments to form a covering. This cover grows, becomes grayish, and solidifies until only the center of the white cap remains (nipple stage) prior to the first molt.

Second Instar:

After the first molt, male scale covers begin to elongate while the covers of female scales remain circular.

Hosts:

- Prime hosts are lemons, grapefruit, Valencia, navel, and Mandarin oranges.
- Occasional hosts — grape, olive, rose, night-shade, eucalyptus, fruitless mulberry, and walnut.

Damage:

- Scales feed on fruit, leaves, and branches.
- Affected fruit is downgraded.
- Severe infestations cause leaf and fruit drop, especially in late summer, limb dieback, and tree death.

Phenology:

- Three to four generation per year in the San Joaquin Valley.
- In coastal and other districts of southern California two to three generations may appear.
- Each generation requires about 1145 D° F or 636 D° C.

Life Stages/Degree-Days:

Life Stage	*Average D° F*	*Average D° C*
First male to crawler	360	200
Crawler to second instar	316	175
Second instar to adult	294	163
Adult	174	97
Generation time	1145	636

(Threshold temps: 53° F or 11.7° C)

Lure:
Pherocon® controlled release septa.

Lure Storage:
Store in unopened, factory-sealed, foil packages in cool place (75° F or 23.9° C maximum).

- Refrigerate or freeze carryover stock for annual storage.

Trap Design:
- Pherocon® V for CRS only (white color).
- Pherocon® VI for CRS and Aphytis parasite (yellow color).

Placement Time:
- Install some traps two weeks before earliest known emergence and prior to male flight; monitor twice weekly for appearance of first male then install remaining traps or consult University Extension Service personnel for timing of flights in region.

Placement Pattern:
- Space evenly through orchard and in vicinity of known scale infestation "clumps".
- Place traps at least four rows in from orchard edge.
- 6 - 8 feet or 1.8 - 2.4 meters high in northeastern quadrant of tree; just inside canopy.
- Place at about 1100 D° F or 611 D° C after first flight bio-fix for second flight.

Trap Density:
- As treatment threshold indicator — one trap per 2.5 acres or 1 hectare.
- As survey monitor — one trap per 5 acres or 2 hectares.
- As monitor for beginning, end and peak of flight- one trap per 5 acres or 2 hectares and no less than 3 traps per any uniform grove.

Trap Maintenance:
- Check traps at least once each week during the male flight period.
- When monitoring male emergence or surveying infestations, change liners at each count or sooner when dirty.
- When using traps for economic threshold determination, collect traps at the end of the flight period, then count.
- Replace lures every 4 to 5 weeks, depending on ambient temperature.

Trap Checking Frequency:
For peak of emergence/bio-fix
- Always monitor the first flight and obtain an accurate bio-fix.
- For second flight, install traps at the end of the first flight (second flight should begin about 1100 D° F or 611 D° C after first flight bio-fix). Check traps twice weekly and average males per trap, per day after each check.

For peak of emergence/bio-fix (cont.)

- Record/chart results to monitor duration and peak of flights.
- When possible, keep records of accumulated degree-days (D°) for each uniform orchard or uniform area (ensure the data relates to your target orchard).

Note: Be careful not to include yellow scale, parasites or other insects in count.

For Economic Thresholds (Or Survey)

- For treatment decisions monitor and count the second and fourth male flights.
- For second flight (late May) and fourth flight, place some traps to monitor for first males emergence pattern. Then place remaining traps to determine population threshold (second flight should begin about 1100 D° F or 611 D° C after first flight bio-fix).
- Always check a few traps twice weekly for males per trap, per day to monitor duration and peak of flights.
- Count males per trap on remaining cards weekly (see attached templates).
- Calculate total males per trap for entire grove or block for duration of flights. At the end of the flight, accumulate total capture for each trap, add total of all traps in the grove then divide by the total number of traps in the grove. Use accompanying table to determine percentage of infested fruit and your desired treatment threshold.

Counting Cards:

- If less than 200 males are caught, use a tally counter.
- If more than 200 males are caught, use a template.
- Best procedure: photocopy template onto clear plastic; cover trap with plastic baggie (to avoid glue), lay template over the card.
- Count front and back of cards and record your trap counts.

Trap Interpretation:

- Recommendations are based on San Joaquin Valley, California navel oranges. Treatment decisions may be based on trap catches for the second and fourth flights and depends on damage thresholds.

Fourth Flight Recommendations:

- Infestation level at the following year harvest will be five to ten times the level of the fourth flight if not treated.
- When fourth flight counts exceed desired thresholds, monitor crawler populations the next spring: at beginning of bloom, tightly wrap infested twigs with transparent tape sticky on both sides.
- Check and replace tape twice weekly.
- Treat after sharp increase in crawler production occurs on the tape.
- Treatment may occur one of two times:
  (1) First generation crawlers occur around petal fall.
  Treat if indicated, but be careful of fruit drop and honey bees.

(2) If crawler production occurs after petal fall...wait for increase, then treat.

Note: If fourth flight indicates no treatment required, recheck the second flight for threshold the following year. If indicated, treat immediately after crawler production begins.

Second Flight Recommendations:

- If second flight trap count exceeds tolerable economic threshold level, treat immediately.
- Second generation crawlers occur about 2 - 4 weeks after the peak of the second male flight. Treat at 555 D° F or 308 D° C (53° F or 11.7° C following peak of flight and/or when crawler counts increase on sticky tape).

For Lemons And Valencia Oranges:

- Use Pherocon® VI pheromone traps to survey numbers and distribution of California red scale and its parasites.
- Monitor second and fourth flights for treatment decisions.
- Supplement with monthly visual inspection.

Supplementary Monitoring Techniques:

- Visually check fruit, twigs, and leaves for scale; typically in August, October, and December. Examine, but do not remove, five fruit from each of four trees near pheromone traps.
- Record fruit with more than ten live scales.
- Whenever possible use management practices and pesticides that minimize disruption to natural enemies of California red scale.

Source: Recommendations and certain other sections were sourced from University of California, "Integrated Pest Management for Citrus."

Never

- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Degree-Day Table

Max Temp	Minimum Temperatures										Lower Threshold: 53° F/11.7° C					
	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70
60	2	2	2	2	2	3	3	4	5	6	7					
62	3	3	3	3	3	4	4	5	6	7	8	9				
64	3	4	4	4	4	5	5	6	7	8	9	10	11			
66	4	4	5	5	5	6	6	7	8	9	10	11	12	13		
68	5	5	5	6	6	7	7	8	9	10	11	12	13	14	15	
70	6	6	6	7	7	8	8	9	10	11	12	13	14	15	16	17
72	7	7	7	8	8	8	9	10	11	12	13	14	15	16	17	18
74	8	8	8	9	9	9	10	11	12	13	14	15	16	17	18	19
76	8	9	9	9	10	10	11	12	13	14	15	16	17	18	19	20
78	9	10	10	10	11	11	12	13	14	15	16	17	18	19	20	21
80	10	11	11	11	12	12	13	14	15	16	17	18	19	20	21	22
82	11	12	12	12	13	13	14	15	16	17	18	19	20	21	22	23
84	12	12	13	13	14	14	15	16	17	18	19	20	21	22	23	24
86	13	13	14	14	15	15	16	17	18	19	20	21	22	23	24	25
88	14	14	15	15	16	16	17	18	19	20	21	22	23	24	25	26
90	15	15	16	16	17	17	18	19	20	21	22	23	24	25	26	27
92	16	16	17	17	18	18	19	20	21	22	23	24	25	26	27	28
94	17	17	18	18	19	19	20	21	22	23	24	25	26	27	28	29
96	18	18	19	19	20	20	21	22	23	24	25	26	27	28	29	30
98	19	19	20	20	21	21	22	23	24	25	26	27	28	29	30	31
100	20	20	21	21	22	22	23	24	25	26	27	28	29	30	31	32
102	21	21	22	22	23	23	24	25	26	27	28	29	30	31	32	33
104	22	22	23	23	24	24	25	26	27	28	29	30	31	32	33	34
106	23	23	23	24	25	25	26	27	28	29	30	31	32	33	34	35

Source: University of California, Division of Agriculture & Natural Resources

Predicted Fruit Infestation Table

Predicted fruit infestation levels based on California Red Scale trap catches in traps baited with a virgin female equivalent pheromone in the San Joaquin valley.

Males per trap in the flight period			Percentage of fruit infested	
First Flight (Apr/May)	Second Flight (Jun/Jul)	Fourth Flight (Sep/Oct)	One or more scale per fruit	11 or more scales per fruit
	0	1,763	2	0.7
0	1,385	6,263	4	1.3
21	3,006	10,893	6	2.0
43	4,679	15,665	8	2.6
65	6,403	20,594	10	3.3
87	8,184	25,697	12	3.9
111	10,028	30,993	14	4.6
135	11,947	36,504	16	5.3
159	13,946	42,257	18	5.9
184	16,038	49,022	20	6.6
211	18,238	54,612	22	7.2
238	20,561	61,354	24	7.9
266	23,030	68,841	26	8.5
295	25,686	76,290	28	9.2
326	28,568	84,744	30	9.8
358	31,749	94,208	32	10.5
392	35,351	105,055	34	11.2
428	39,602	118,331	36	11.8
466	45,067	136,864	38	12.5
508	55,246	167,200	40	13.1

Please note: Fruit not generally scored as infested by packing houses unless they have patches of more than 10 scales per fruit.
 # Reference: "Integrated Pest Management for Citrus," University of California, Statewide Integrated IPM Project, Publication 3303 (1991).

Description:

Adults:

About 0.4 in or 10 mm long, gray with dark spots, with fringe on the wings.

Larvae:

Larvae are about 0.3 in or 8 mm long, white to greenish in color with brown head.

Damage:

- Heavy populations can reduce yield by feeding on blossoms and young fruit.
- Will also mine fruit which can cause it to be culled for fresh shipment, especially for export.
- Can also feed in grafts.

Phenology:

- Three to five generations per year.

Lure:

- Pherocon® controlled release septa.

Trap Design:

- Pherocon® 1C.

Placement Time:

- One week before known emergence.

Placement Pattern:

- Within orchard — grid pattern; within tree 6 - 7 feet or 1.8 - 2.1 meters high; northern or eastern quadrant.

Trap Density:

Number of traps	*Acres*	*Hectares*
Minimum of 3	30	12
1 per 10 acres or 4 hectares	30 - 80	12 - 32
1 per 20 acres or 8 hectares	>80	>32

Trap Maintenance:

- Check 2 to 3 times a week; remove insects; stir glue when checking.
- Replace lures every 4 to 6 weeks.
- Replace liners when fouled with dust or insect debris, or after 200 moths have been counted and removed from liner.

Recommendations:

- Use traps to indicate when to initiate flower monitoring during April and May.
- Treatment is recommended if over 4 - 5% of the flowers, or 2 - 3% of the fruit, are infested with larvae or eggs in a 300-flower sample.
- Another recommendation is to take a random sample of 50 flowers per tree on 10% of the trees in a grove. Treatment is suggested if 5% of the flowers are infested or 2 - 3% of the fruit is attacked. Research in Sicily indicates Bacillus thuringiensis will control larvae of this moth.

Never

- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Description:

Adults:

Gray mottled moths with a coppery band at the tips of the wings.

Eggs:

Pinhead sized, disc-shaped and transparent white when first laid. As they mature they become opaque white and develop a red ring. Just before hatching the black head of the larva becomes visible.

Larvae:

Newly hatched larvae are pinkish white with a black head. Mature larvae are about 0.75 in or 19 mm long and pinkish white with a mottled brown head. In walnuts, codling moth larvae look similar to those of the navel orange worm. However, they do not have the crescent-shaped marks on the second segment that distinguish navel orange worm larvae.

Hosts:

Apples, pears, walnuts, plums.

Damage:

Pome and Stone Fruits

- Codling moth larvae mainly damage fruit with deep entries and stings.
- In deep entries, larvae bore to the core and feed in the seed cavity area.
- Stings occur primarily when a stomach poison is used and larvae enter the fruit a short way before dying. Affected areas heal leaving a small scar.
- Larvae may enter through the sides, stem end, or calyx end of the fruit.

Walnuts

- Damage caused by codling moth is different with each generation.
- First generation larvae reduce yield directly by causing nutlets to drop from tree. They also serve as breeding site for navel orangeworm. Damaged nutlets have frass at the blossom end.
- Nuts attacked by second generation remain on trees but are unmarketable because of feeding damage on kernel. Feeding damage can also be detected by looking for frass produced by larvae at the point of entry into the husk. Also serves as breeding site for NOW.

Phenology:

- Two to four generations per year depending on weather and location.
- Overwinters as full-grown diapausing larva.
- Emerges March or April in California; emerges in late April or May in Washington.

Life Stages/Degree-Days:

Life Stage	*Average D° F*	*Average D° C*
Preoviposition period	58	32.2
Egg Hatch begins	158	87.7
Larval Development	471	261.4
Pupal Development	431	239.2
Generation time (first)	1060	588.3
Generation time (second and third/CA)	1320	732.6

(Threshold temps: 53° F or 11.7° C)

Lure:

- For use in conventionally treated orchard:
  Standard Pherocon® CM controlled release septa or Pherocon® CM L2™ septa.
- For use in mating control orchard only:
  Pherocon® CM 10X lure in concurrence with standard Pherocon® CM controlled release septa lure (but in separate traps).

Lure Storage:

- Store in unopened factory-sealed packages in a cool place (75° F or 23.9° C maximum).
- Refrigerate or freeze carryover for annual storage.

Trap Design:

- Pherocon® 1CP or Pherocon® II B.

Placement Time:

- Before spring emergence, at bud break.

Placement Pattern (in non-disrupted orchards):

- Within orchard — grid pattern.
- In orchards differing in spacing, age, tree size or culture place traps to account for difference.
- Within tree — 6 - 8 feet or 1.8 - 2.4 meters high, SE quadrant.
- Within canopy, but unblocked by leaves or developing fruit.

Trap Density (in non-disrupted orchards):

California Apples

Number of traps	Acres	Hectares
Minimum of 2	≤10	≤4
One trap per 5 - 10 ac or 2 -4 ha	10-100	4 - 40

California Walnuts

Minimum of 2	10	≤4
One trap per 10 acres or 4 ha	11-100	4-40
One trap per 15 acres or 6 ha	>100	>40

Trap Density(in non-disrupted orchards)continued:

Washington Pome Fruits

- One trap per 2.5 acres or 1 hectare.
- These 2.5 acre or 1 hectare blocks represent trapping stations.

Placement Pattern(in mating-disrupted orchards):

- A set of 2 traps should be used to monitor in mating disruption orchards.
  One Pherocon® 1CP trap/CM 10X lure in upper third of tree.
  One Pherocon® 1CP trap/standard CM lure 6 - 8 feet or 1.8 - 2.4 meters high.

Note: Place trap sets in adjacent trees, crosswind from each other. Do not place traps downwind from each other.

Trap Density(in mating-disrupted orchards):

- A set of 2 traps per 2.5 acres or 1 hectare.

Trap Maintenance:

- Check daily until bio-fix, weekly thereafter.
- Remove insects and stir glue when checking.
- Replace Pherocon® Standard 10X lures every 3 weeks, and Standard Low rate (new Controlled Release Plus™ lures) every 4 weeks.
- Replace liners every six weeks or when fouled with dust or insect debris (trap efficiency goes down after 25 or more moths have been caught).

  Caution: If pheromone traps are being used to monitor other pest species, do not use the same instrument to clean both traps. Contamination of the codling moth trap with other pheromones may inhibit its ability to catch.

  Warning: Guidelines for codling moth trap use varies depending on crop, area and intended use of trap data. Fewer traps will be needed to determine insect phenology than when being used for treatment thresholds. Trap count data utilized for treatment thresholds were developed based on traps being used in a specific manner. Any variation in trap use from recommended guidelines will impact numbers caught in traps and invalidate thresholds. Be sure to follow trap use instructions developed in your area, and consult with the appropriate agency for more information.

CM Treatment Decisions for California Apples:

Trap Counts	*Population Levels*	*Comments*
10 moths/trap/week	High population	Requires heavy pesticide use. If left untreated, heavy damage will result.
3 - 10 moths/trap/week	Medium population	Sprays should be applied accurately for each gen.
2 moths/trap/week	Low population	Sprays are sometimes unnecessary, but be sure to monitor fruit for damage.

CM Treatment Recommendations/Schedule for California Apples:

(First Generation):

- Set first bio-fix when moths are consistently found in traps, unless sunset temperatures are less than 62° F or 16.6° C.

For Synthetic Organic Insecticides:

- For historically low populations, spray once at 400 - 500 D° F or 222 - 278 D° C.
- With moderate to high populations, or low populations with no historical data, spray at 250 - 300 D° F or 139 - 166.5 D° C from bio-fix, reapply when residual effectiveness of first treatment ends.

Caution: If two or more peak periods of activity occur in cool springs, control each egg hatch 111 - 214 D° F or 62 - 119 D° C from corresponding period of activity.

(Second Generation):

- Set second bio-fix by using increase in flight activity between 900 - 1200 D° F or 500 - 666 D° C.

For Synthetic Organic Insecticides:

- With low to moderate populations spray at 200 - 250 D° F or 111 - 139 D° C from second bio-fix.
- With high populations apply first treatment 1050 - 1150 D° F or 583 - 638 D° C from first bio-fix.
- If trap catches are consistently high, apply second treatment when residual effectiveness of first treatment ends.

(Third Generation):

For Synthetic Organic Insecticides:

- Diapause triggered by reduction of daylight around August 15 to 22.
- If 541 D° F or 300 D° C accumulated from second bio-fix by mid August, set third bio-fix around 1100 - 1200 D° F or 611 - 666 D° C from second bio-fix.
- Treat 200 - 250 D° F or 111 - 139 D° C from third bio-fix.

CM Treatment Recommendations/Schedule for California Walnuts:

- Check traps frequently until bio-fix (which is marked by the beginning of a consistent increase in trap capture).
- Accumulate degree-days; monitor 2 times weekly.
- Spray at 300 D° F or 167 D° C from beginning of first flight, if indicated by CM and NOW damage from previous year, current trap capture levels, and nut drop.
- If large bimodal peak observed for first flight, consider reapplication.
- Continue monitoring for second flight, control if needed.
- Verify your degree-day predictions by regularly scouting the orchard. Look for nuts with frass on the ends or sides, crack them open and check the size of the larvae within. If scouting reveals development to be ahead or behind your degree- day predictions, be aware of this discrepancy when planning future treatments.

Recommendations/Schedule for Washington Apples:

(First Generation):

- Set first bio-fix (in orchards with historically low populations, check with your local extension office).
- Begin accumulating D°.
- If threshold of 6 moths per trapping station is exceeded, apply first cover at 250 D° F or 139 D° C.
- Application should be made at 250 D° F or 139 D° C, even if threshold is reached before this time.

First Threshold Not Reached:

- Apply delayed first cover at 360 D°F or 200 D° C if threshold reached.
- Re-set moth accumulation at zero.

First Threshold Reached:

- Apply second cover in 21 days if threshold reached.
- Apply second cover if threshold exceeded in next 21 days.

If more than 10 moths are captured between bio-fix and 250 D° F or 139 D° C, high pressure is indicated and a second cover should be applied.

Apply control measures for leafrollers and other pests as necessary.

(Second Generation):

- Re-set moth accumulation to 0 at 1000 D° F or 555 D° C from first bio-fix.
- Same treatment guidelines apply as for first generation.

Note: Treatment threshold decreases to 5 moths per trapping station.

Supplementary Monitoring Techniques:

- Examine leaves or fruit clusters in the orchard for eggs.
- Eggs are frequently laid at the base of fruit clusters where stems come together.
- Trap mature larvae as they move down the tree to pupate. Trap in a band of tanglefoot, burlap bags or corrugated cardboard around the trunk.
- Check fruit for sting or entry wounds. Small holes covered with frass on fruit surfaces are characteristic.

Source: Recommendations and certain other sections were sourced from "Orchard Pest Management. A Resource Book for the Pacific Northwest" as well as University of California, "Integrated Pest Management for Apples and Pears" and "Integrated Pest Management for Walnuts."

Never

- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Degree-Day Table

Max Temp	*Minimum Temperatures*												
	36	38	40	42	44	46	48	50	52	54	56	58	60
118	21	22	22	23	23	24	24	25	26	27	28	28	29
116	21	22	22	23	23	24	24	25	26	27	27	28	29
114	21	21	22	22	23	23	24	25	26	26	27	28	29
112	21	21	22	22	22	23	24	24	25	26	27	28	29
110	21	21	21	22	22	23	23	24	25	26	27	28	28
108	20	20	21	21	22	22	23	24	25	26	27	27	28
106	20	20	21	21	22	22	23	24	24	25	26	27	28
104	20	20	20	21	21	22	22	23	24	25	26	27	28
102	19	19	20	20	21	21	22	23	24	25	26	27	27
100	19	19	19	20	20	21	22	22	23	24	25	26	27
98	18	19	19	19	20	21	21	22	23	24	25	26	27
96	18	18	19	19	20	20	21	22	23	23	24	25	26
94	17	18	18	18	19	20	20	21	22	23	24	25	26
92	17	17	17	18	18	19	20	20	21	22	23	24	25
90	16	16	17	17	18	18	19	20	21	22	23	24	25
88	15	16	16	16	17	18	18	19	20	21	22	23	24
86	14	15	15	15	16	17	17	18	19	20	21	22	23
84	13	14	14	15	15	16	16	17	18	19	20	21	22
82	12	13	13	14	14	15	15	16	17	18	19	20	21
80	11	12	12	13	13	14	14	15	16	17	18	19	20
78	11	11	11	12	12	13	13	14	15	16	17	18	19
76	10	10	10	11	11	12	12	13	14	15	16	17	18
74	9	9	9	10	10	11	11	12	13	14	15	16	17
72	8	8	8	9	9	10	10	11	12	13	14	15	16
70	7	7	8	8	8	9	9	10	11	12	13	14	15
68	6	6	7	7	7	8	8	9	10	11	12	13	14
66	5	6	6	6	6	7	7	8	9	10	11	12	13
64	4	5	5	5	5	6	6	7	8	9	10	11	12
62	4	4	4	4	5	5	5	6	7	8	9	10	11
60	3	3	3	3	4	4	4	5	6	7	8	9	10

Source: University of California, Division of Agriculture & Natural Resources

Degree-Day Table

Lower Threshold: 50˚ F or 10˚C
Upper Threshold: 88˚ F or 31.1˚ C

62	64	66	68	70	72	74	76	78	80	82	84	86	88	90
30	31	32	32	33	34	35	35	36	36	37	37	38	38	38
30	31	31	32	33	34	34	35	36	36	37	37	38	38	38
30	31	31	32	33	34	34	35	36	36	37	37	38	38	38
30	30	31	32	33	34	34	35	36	36	37	37	38	38	38
29	30	31	32	33	33	34	35	36	36	37	37	38	38	38
29	30	31	32	32	33	34	35	35	36	37	37	38	38	38
29	30	31	31	32	33	34	35	35	36	37	37	38	38	38
29	30	30	31	32	33	34	34	35	36	37	37	38	38	38
28	29	30	31	32	33	34	34	35	36	37	37	38	38	38
28	29	30	31	32	32	33	34	35	36	36	37	38	38	38
28	29	30	30	31	32	33	34	35	36	36	37	38	38	38
27	28	29	30	31	32	33	34	35	35	36	37	38	38	38
27	28	29	30	31	32	33	33	34	35	36	37	38	38	38
26	27	28	29	30	31	32	33	34	35	36	37	37	38	38
26	27	28	29	30	31	32	33	34	35	36	36	37	38	38
25	26	27	28	29	30	31	32	33	34	35	36	37	38	
24	25	26	27	28	29	30	31	32	33	34	35	36		
23	24	25	26	27	28	29	30	31	32	33	34			
22	23	24	25	26	27	28	29	30	31	32				
21	22	23	24	25	26	27	28	29	30					
20	21	22	23	24	25	26	27	28						
19	20	21	22	23	24	25	26							
18	19	20	21	22	23	24								
17	18	19	20	21	22									
16	17	18	19	20										
15	16	17	18											
14	15	16												
13	14													
12														

Source: University of California, Division of Agriculture & Natural Resources

Description:

Adults:

Yellow forewing with very visible brown band wingspan of 0.49 - 0.61 in or 12 - 15 mm.

Eggs:

Females deposit 40 - 60 eggs. First generation hatch in 10 - 15 days — second generation hatches in 7 - 10 days. Eggs are lentil shaped. Color ranges from "lemon" yellow to "orange" yellow.

Larvae:

Reddish in color, with a black head. Measures 0.41 - 0.45 in or 10 - 11 mm in length.

Pupae:

Chyrsalis, brown/yellow to brown/red in color. Large in size, measuring 0.20 - 0.33 in or 5 - 8 mm in length.

Hosts:

Primarily cultivated vines; found on 30 other species, although rarely.

Damage:

- First generation larvae hatch and penetrate flowers and build nests of flowers. The second generation larvae penetrate directly peduncles and young fruit. They then facilitate the development of "gray rot" (Botrytis cinerea).

Distribution:

From the borders of the Mediterranean Sea to the south of Great Britain and Scandanavia, in central and Balkan Europe, the south of Russia, in the Caucasus, in Kazakstan and Uzbekistan, as well as in the eastern parts of Asia, such as China and Japan.

Phenology:

- Overwinter as pupa in a chyrsalis under bark.
- Emerge in mid-April to mid-May.
- First flights last 3 - 5 weeks.
- Second generation adults emerge in early July.
- Second flights last 3 - 6 weeks.
- Two generations per year.

Lure:

Pherocon® controlled release septa.

Lure Storage:

- Store in unopened factory-sealed packages in a cool place (75°F or 23.9°C maximum).
- Refrigerate or freeze carryover for annual storage.

Trap Design:
• Pherocon® 1C or Pherocon® III Delta.

Placement Time:
• Place in vineyard in early April or one to two weeks before earliest known emergence.

Placement Pattern:
• In grid pattern throughout vineyard.

Trap Density:
• Never use less than two traps.
• On large uniform plantings, use one trap in 7.5 acres or three hectares.

Trap Maintenance:
• Check traps at least once, but preferably twice per week.
• Change lures monthly.
• Change liners monthly or when dirty or after catching a maximum of 200 moths.

Recommendations:
• First generation treatment is not suggested unless more than 100 moths per trap are captured.
• Use traps to determine generation development and best time to monitor bunches for the presence of eggs or larvae.
• Schedule control measures in accordance with recommendations of local authorities.
• Mating disruption and Bacillis thuringiensis have both performed well in controls.

Source: Recommendations and certain other sections were sourced from Station fédérale de recherches agronomiques de Changins, Nyon, Switzerland.

Never
• Use more than one lure per trap
• Fail to count as recommended
• Fail to record trap counts
• Fail to change liners when needed
• Fail to change lure as recommended
• Discard lures within field
• Fail to follow recommendations

Description:

Adult:

Brownish in color, 0.50 - 0.64 in or 14 - 16 mm long.

Eggs:

Females deposit 40 - 60 eggs. First generation eggs hatch in 7 - 14 days, but later generations can hatch in 4 - 6 days.

Larvae:

Young larvae have black head with a reddish body. The mature larva is gray to greenish in color.

Hosts:

Primarily cultivated vines.

Distribution:

Found throughout Europe and other meridional regions.

Damage:

- First generation feeds on flower clusters early in season.
- After berry set they feed in berries often injuring several.
- As berries ripen, rot organisms invade feeding sites in berries.

Phenology:

- Overwinters as pupa inside cocoon under bark.
- Emerge in April or May.
- Overwintered females lay eggs on florescence or peduncle.
- The first flight lasts for 2 - 6 weeks.
- Later generation females lay eggs on the fruit.
- The second generation begins emerging in June with a third generation emerging in August and September.
- There are three to four generations per year.

Lure:

Pherocon® controlled release septa.

Lure Storage:

- Store in unopened factory-sealed packages in a cool place (75°F or 23.9°C maximum).
- Refrigerate or freeze carryover for annual storage.

Trap Design:

- Pherocon® 1C or Pherocon® III Delta.

Placement Time:
• Place in vineyard in mid-April or before emergence of overwintered generation.

Placement Pattern:
• In grid pattern throughout vineyard.

Trap Density:
• Never use less than two traps.
• One trap per 2.5 acres or 1 hectare.

Trap Maintenance:
• Check traps at least once, but preferably twice per week.
• Change lures monthly.
• Change liners monthly or when dirty or after catching a maximum of 200 moths.

Recommendations:
• In Switzerland, first generation treatment is not suggested unless more than 200 moths per trap are trapped.
• Use traps to determine generation development and best time to monitor bunches for the presence of eggs or larvae.
• Schedule insecticide treatments by treating as soon as larvae begin to hatch.

Source: Recommendations and certain other sections were sourced from Station fédérale de recherches agronomiques de Changins, Nyon, Switzerland.

Never
• Use more than one lure per trap
• Fail to count as recommended
• Fail to record trap counts
• Fail to change liners when needed
• Fail to change lure as recommended
• Discard lures within field
• Fail to follow recommendations

Description:

Adults:

Tan with two golden bands running across the forewings, which present a bell shape when at rest. Adult wingspan is about 0.5 in or 14 mm.

Eggs:

Laid singly on upper surface of leaves, less than 4 in or 10 cm from nut clusters in upper canopy.

Larvae:

Mature larva is white and about 0.5 in or 12 mm long.

Host:

Hazelnuts, walnuts, wild hazelnuts, Catalina cherries, apricots, prunes, chestnuts and oak acorns.

Damage:

- First instar larvae bore into the husk and shell.
- Larvae feed in nuts for about 2 weeks, chew exit holes and drop to soil.
- Early damage causes abortion of developing nutlet. Feeding in developing nut destroys kernel.
- Exit hole provides access point for Indian mealmoth and other stored product Lepidoptera.

Phenology:

- One generation per year (sometimes there is a partial second generation involving about 10 - 15% of the population).
- Overwinters as larvae in silken cocoon in soil, leaves and trash on ground.
- Emerges in mid to late May (prolonged emergence expected).
- Earliest emergence May 19 (Willamette, Oregon).

General Development Periods:

- Pupal Emergence - May through August.
- Adult Emergence - Mid-June through October.
- Oviposition - July to Mid-October.
- First Larval Emergence - 10 days following oviposition.
- Damage Period - July and August.

Lure:

- Pherocon® controlled release septa.

Lure Storage:

- Store in unopened, factory-sealed storage packages in a cool place (75° F or 23.9° C maximum).
- Refrigerate or freeze carryover for annual storage.

Trap Design:
• Pherocon® 1C trap.

Placement Time:
• One to two weeks before emergence.
• Or June 1 to June 15.
• Or according to Oregon State University emergence notice based on accumulated degree-days.

Placement Pattern:
• Pattern within orchard — grid pattern.
• Within tree, upper 1/3 of canopy.
• Three rows in from border.

Trap Density:
• Minimum 2 - 3 traps, no closer than 60 - 70 feet or 18 - 21 meters.

Density	*Acres*	*Hectacres*
One trap per 2.5 acres or 1 ha	< 10	< 4
Add one trap per 4 acres or 1.6 ha	≥ 10	≥ 4

Note: if economic threshold used for timing, trap density recommendations must be strictly followed.

Trap Maintenance:
• Check twice each week.
• Replace lures every 5 weeks.
• Replace liners every 5 weeks or when dirty.

Recommendations:
• Accumulate average trap catch per orchard from time of trap placement.
• Apply control treatments to entire orchard when accumulated average reaches a total of 2 - 3 moths per trap.

Or
• Treat entire orchard when accumulated total reaches 5 moths per trap in any single trap in orchards < 50 acres or < 20 hectares.
• Reset accumulative moth capture total to zero at the end of the anticipated insecticide residual period (14 - 21 days depending on the compound).
• Reapply control treatments when the new accumulated trap capture exceeds the above threshold values (i.e. at 2 - 3 cumulative moths per trap, per orchard or 5 moths cumulative per any single trap).

Note: If orchard > 50 acres or > 20 hectares, spot treatments can be made to portion of orchard when any single pheromone trap capture reaches a cumulative total of 5 moths per trap.

Source: Recommendations and certain other sections were sourced from Oregon State University "Extension Bulletins/Pest Management Guidelines."

Never

- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Description:

Adults:

Mottled light and dark brown forewings with a prominent light triangular spot on the outside edge of the wing. Hind wings are smokey gray.

Eggs:

Laid on twigs and branches in irregular masses of 30 to 100. Covered with a secretion, which is dull orange when first laid, but turns brown in summer, to gray in winter.

Larvae:

Young larvae are light green with a black head. The body darkens as larvae mature, to dark green. Thoracic shield is dark brown to black, often with white or cream leading edge.

Pupae:

In thin cocoons within leaf rolls. Light green to greenish brown at first, turning to tan and then dark brown before emergence.

Hosts:

Attacks a wide range of fruit and ornamentals including, but not limited to, apricot, almond, apple, caneberry, citrus, cherry, hazelnut, pear, plum, quince, walnut, ash, birch, live oak, California buckeye, boxelder, elm, locust, maple, poplar, rose, and other plants.

Distribution:

Native to U.S. Found in all apple growing areas.

Damage:

- Larvae feed on leaves, buds and fruit.
- Skeletonizes leaves near midrib on underside.
- Folds and webs them together with silken threads.
- In extreme cases may cause severe defoliation.
- Eats cavities from side of young fruit causing deep russetted scars at harvest.

Phenology:

- Overwinters in egg stage.
- Eggs hatch from February to late March, depending on location.
- Adults emerge in early May in California and early June in areas such as Oregon, Washington and Michigan.

Lure:

Pherocon® controlled release septa.

Lure Storage:

- Store in unopened factory-sealed packages in a cool place (75° F or 23.9° C maximum).
- Refrigerate or freeze carryover for annual storage.

Trap Design:
• Pherocon® 1C.

Placement Time:
• Early May in California, to early June in cooler regions.

Placement Pattern:
• Within orchard: grid pattern.
• Within tree, 6 - 7 feet or 1.8 - 2.1 meters on outer edge of canopy in northern or eastern quadrant.

Trap Density:

Number of Traps	*Acres*	*Hectares*
Minimum of 4 per orchard	> 10	> 4

Trap Maintenance:
• Check once or twice per week.
• Change lures once per month.
• Change liners monthly; or after catching 50 moths; or when liners become dirty.

Recommendations:
• Numbers can be used as rough guideline to determine population levels for the following year.
• Capture of 15 or fewer moths per week usually, although not always, indicates little potential for damage.
• However, higher trap counts do not always indicate a damaging population.
• Conduct larval samples the following spring if the previous season's trap count was significant.

Supplemental Monitoring:
• Collect 150 fruit buds from a 5 acre or 2 hectare block. Check under a microscope in the laboratory to get an idea if a delayed dormant treatment is needed for fruittree leafroller.
• From tight cluster or pink, examine 20 fruit buds from 20 trees to estimate larval density.

Never
• Use more than one lure per trap
• Fail to count as recommended
• Fail to record trap counts
• Fail to change liners when needed
• Fail to change lure as recommended
• Discard lures within field
• Fail to follow recommendations

Description:

Adults:

Clear-winged moths are a dark blue color with bright orange bands on the 4th and 5th abdominal segment. Females are slightly larger than males. Abdominal segments may be fringed with white or yellow scales on males.

Eggs:

Flattened, disk-shaped oval that is 0.02 in or 0.5 mm in diameter and reddish brown in color. They are usually deposited singularly or in small groups near the base of the tree trunk.

Larvae:

White or cream colored, they feature a yellow-brown to dark brown head.

Pupae:

Female is slightly larger than the male and darker in color. They develop an orange band on the abdomen as they mature. Peachtree borer larvae pupate under bark.

Distribution:

Native to America, common in most fruit growing areas.

Hosts:

Peach, cherry, prune, apricot, nectarine, plum, wild plum, flowering trees and shrubs of the genus Prunus, and related plants.

Damage:

- Primary damage is caused by larvae feeding in the cambium layer usually on the trunk.
- Damage is usually a few inches above to a few inches below ground level. Young trees can be completely girdled and killed. Older trees usually are not killed, but lower vigor make them more susceptible to other insects and diseases.
- Infested trees bleed frass infested gum from damaged areas during the growing season.

Phenology:

- Overwinters as larvae under tree bark usually below ground.
- Become active when soil temperatures reach 50° F or 10° C and feed on live tissue under bark.
- Moths emerge in late June to early July and continue emerging to September.
- Most eggs are deposited on the day of emergence.
- Eggs hatch in 9 - 10 days and larvae bore into trunk and begin feeding in the cambium layer.

Developmental Thresholds (Peach):

Lower 50° F or 10° C ..... Upper 87.8° F or 31.0° C.

Start Date for Degree-days Accumulation: ..... January 1.

Start of Consistent Trap Catches: ..... 1440 D° F or 800 D° C.

50% Accumulative trap Catch: ..... 2323.8 D° F or 1289.7 D° C.

Lure:
• Pherocon® controlled release septa.

Lure Storage:
• Store in unopened factory-sealed packages in a cool place (maximum of 75° F or 23.9° C).
• Refrigerate or freeze carryover stock for annual storage.

Trap Design:
Pherocon® 1C.

Placement Time:
• California: April 15 to May 1.
• Washington: May 15 to June 1.
• Pennsylvania: June 1.

Placement Pattern:
• Within orchard grid pattern throughout the orchard.
• Within the tree, 3 - 4.5 feet or 1 - 1.5 meters high near trunk.

Trap Density:

Number of Traps	*Acreage*	*Hectares*
Minimum of 2 per orchard	–––	–––
One per 5 acres or 2 hectares	≥ 10	≥ 4

Trap Maintenance:
• Check 2 times per week.
• Replace lures every 4 weeks.
• Replace liners every 6 weeks or when dirty.

Recommendations:
• Use trap counts for detection of adults or to time insecticide treatments (treat 3 days after first catch).
• Treat when capture of adults reaches or exceeds 10 moths per trap per week.
• Continue monitoring into mid-September.

Source: Recommendations and certain other sections were sourced from University of California "Integrated Pest Management for Peaches and Nectarines."

Never

- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Description:

Adults:

Small wingspan is about 0.4 in or 10 mm. Forewings are a dark-brownish/black color, tinged with purple, with 5 - 7 pale yellowish streaks along front of wing.

Eggs:

0.03 in or 1 mm. Pearly white color, later turning reddish. Deposited by females on nuts/foliage of host or pecan phylloxera galls before nuts are present.

Larvae:

0.3 - 0.4 in or 8 - 10 mm long, when mature, creamy white color with brownish head. They tunnel to surface of shucks and cut an opening from which adults can emerge. They can develop in pecan phylloxera galls.

Pupae:

0.2 - 0.3 in or 5 - 8 mm long, usually found within shucks. Light yellowish color, changing to almost black before emergence.

Hosts:

- Pecans, hickory and walnut.

Damage:

- Larvae enter nuts, cause abortion before "half shell" hardening stage.
- Larvae mine within the shuck, adversely affecting the kernel and shuck split.
- Most damaging of all pecan pests in 5 southern states. Damage reduces excellent crops to unsaleable in many cases.

Phenology:

- 4 - 5 generations per year.
- Emerge in mid-April through October, varying widely with temperature. Some reports indicate mid-February emergence.
- Egg stage lasts 4 - 7 days; larval stage is 19 - 55 days, with average duration 33 days; pupal stage is 4 - 13 days, with average duration 9 days.

Lure:

- Pherocon® HSW L2™ formulation.

Lure Storage:

- Store in unopened, factory-sealed, foil packages in cool place (75° F or 23.9° C maximum).
- Refrigerate or freeze carryover stock for annual storage.

Trap Design:

- Pherocon® 1C.

Placement Time:

- Usually in early April, unless unseasonably early high temperatures — then earlier.

Placement Pattern:

- Within orchard, 3 rows in from edge; grid pattern within orchard.
- Within tree, near center.
- 15 - 30 feet or 45 - 90 meters high for best results, though lower placement results in lower capture.

Trap Density:

Number of Traps	*Acreage*	*Hectacres*
Minimum of 3	< 30	< 12
1 per 5 acres or 2 hectares	30 - 80	12 - 32
1 per 10 acres or 2 hectares	> 80	> 32

Trap Maintenance:

- Check 2 - 3 times a week.
- Remove insects and stir glue when checking.
- Replace lures every 4 to 6 weeks.
- Replace liners when fouled with dust or insect debris, or after 200 moths have been counted and removed from liner.

Treatment Schedule:

Note: Work is progressing on use of the Pherocon® monitoring system as basis for a treatment threshold, although it may take 2 - 3 more years. Pest managers should follow recommendations of local pest managers. Use the following as experimental guidelines.

- Use traps to detect the presence/absence of HSW, and continue to monitor throughout the season.
- Mid-May emergence creates little or no damage. However, damage can occur with emergence in early- to mid-July and from August to early September.
- No accurate treatment threshold exists. Therefore, treat when trap counts begin to increase and retreat as necessary — most likely a second time during "half shell" hardening, which should also be monitored very closely.

Supplementary Monitoring Techniques:

- Monitor for shell hardening and watch for egg deposition and presence of larvae. Check for damage nutlets early in season.

Never

- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Description:

Adults:

Both sexes are clear wing moths with the head, thorax, body, legs and antennae a metallic blue-black with pale yellow markings. Pale yellow bands border the second and fourth abdominal segments. Antennae of males are finely tufted; female antennae are long and slender.

Eggs:

Oval, cinnamon or rust brown color, about 0.02 in or 0.6 mm long. Egg surface is finely netted.

Larvae:

Newly hatched larvae are about 0.04 in or 0.7 mm long. The head is yellowish-brown with a light tan body. Full-grown larvae are 0.8 - 1 inch or 20 - 26 mm long, have a creamy white body with a yellowish brown head and thoracic shield.

Pupae:

Cocoons are oblong, elongated, and constructed from chips of bark and wood grass held together by silken strands. New cocoons are light yellowish brown, but become rust colored as they age. The elongated and cylindrical pupae are light tan, and 0.4 - 0.7 in or 10 - 17 mm long. Abdominal segments have rows of sharp spines.

Hosts:

Peaches, cherries, plums and related plants in genus Prunus.

Damage:

- Larvae feed on tender growing bark at the edge of injured areas and may entirely girdle limbs resulting in death.
- Larvae are common under bark at wounds or injured locations on the tree.
- They may be found in previously injured areas in the trunk, scaffold limbs or branches; around pruning wounds, areas damaged by disease or harvesting equipment.
- Insect or winter injured areas or sun-scalded bark are also frequent locations of infestation.

Phenology:

- There is one generation per year in the North. Overwinters in various larval stages.
- In spring, larvae feed until they mature, and then bore to just below the surface of the outer bark and emerge.
- Moths emerge and fly from late May to September in northern areas with peak emergence in mid to late June depending on the area.
- Mating usually occurs within one hour of emergence. Ovipositon follows shortly after mating.
- Eggs are deposited from ground level to 8 feet or 2.4 meters high in cracks and bark crevices. Eggs hatch in 7 to 10 days and young larvae invade wounded tissue.

Lure:
• Pherocon® controlled release septa.

Lure Storage:
• Store in unopened factory-sealed packages in a cool place (75° F or 23.9° C maximum).
• Refrigerate or freeze carryover stock for annual storage.

Trap Design:
• Pherocon® 1C.

Placement Time:
• Mid to late May depending on location.

Placement Pattern:
• Within orchard grid pattern throughout the orchard.
• Within the tree, 4 - 6 feet or 1.2 - 1.8 meters high, near the trunk.

Trap Density:

Number of Traps	*Acres*	*Hectares*
Minimum of 2 per orchard	----	----
One per 5 acres or 2 hectares	≥ 10	≥ 4

Trap Maintenance:
• Check 2 times per week.
• Replace lures every 4 weeks.
• Replace liners every 6 weeks or when dirty.

Recommendations:
• Use traps for detection of adult emergence.
• Treat when capture of adults reaches or exceeds 10 moths per trap per week.
• Continue monitoring into September.

Source: Recommendations and certain other sections were sourced from University of California "Integrated Pest Management for Peaches and Nectarines."

Never
• Use more than one lure per trap
• Fail to count as recommended
• Fail to record trap counts
• Fail to change liners when needed
• Fail to change lure as recommended
• Discard lures within field
• Fail to follow recommendations

Description:

Adults:

The adult is 0.14 - 0.2 in or 3.5 - 5 mm long and has a yellow head and iridescent green eyes. Long setae surrounded by black spots are present on the dorsum of the thorax. Wings are smoky with orange lines.

Eggs:

The tiny curved egg is 0.04 in or 1 mm long, smooth, white, and very slender. The adult prefers soft spots or previous oviposition sites. A female may lay up to 65 eggs per day and 400 or more eggs over a lifetime.

Larvae:

The larva is an elongated, 11 segmented maggot, typically white or almond colored. It attains a maximum length of about 0.3 in or 8 mm. Larvae feed 6 - 10 days at 76 - 79° F or 24.4 - 26.1° C then drop to the ground and pupate. Mature larvae may jump several inches when disturbed.

Pupae:

Usually found under the soil surface. Pupae are cylindrical, dark reddish-brown, about 0.16 in or 4 mm long, somewhat resembling a swollen grain of wheat.

Pupal period lasts from 6 - 13 days at 76 - 79° F or 24.4 - 26.1° C, but may last for several months in cool months.

Distribution:

Widely distributed in Mediterranean region and other tropical regions throughout the world.

Damage:

- Can attack many different fruits and vegetables including peaches, apricots, apples, pears, citrus, and prunes.
- Eggs are deposited in groups under the skin of host fruit.
- Larvae feed in groups within the pulp of maturing or over-ripe fruit allowing rot organisms to invade the fruit.

Phenology:

- Overwinters — Pupal stage.
- Egg Hatch — 2 to 4 days.
- Larval Development — 11 - 13 days.
- Pupal Emergence — 9 - 12 days.
- Many generations are possible.

Lure:

- Pherocon® controlled release septa.

Trap Design:

- Pherocon® 1C or Pherocon® II.

Placement Time:

- Continuous — warm, tropical climes.
- 45 Days Preharvest — temperate climes.

Placement Pattern:

- 6 - 7 feet or 1.8 - 2.1 meters high.
- SE quadrant.
- Prune shoots and leaves.
- Avoid equipment and irrigation lines.

Trap Density:

Number of Traps	*Acreage*	*Hectares*
Minimum of 2 per orchard	----	----
One per 2.5 acres or 1 hectare	< 20	< 8

Trap Maintenance:

- Change lure at 3 week intervals.
- Change sticky liner or trap when dirty.

Recommendations:

South Africa:

- Quarantine and eradication — treat at one fly.
- At 4 flies per trap per week or less — initiate bait program.
- At more than 4 flies per trap per week — initiate full cover spray.
- Very high counts — identify source and take drastic action.

Note: Contact your local authorities for regional recommendations.

Never

- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Description:

Adults:

Adult moth has a gray head, body and legs. Forewings are covered with brick-red and copper colored patches separated by irregular bands of gray. Hindwings are gray-brown. Wingspread is about one half inch.

Eggs:

Eggs are light greenish when laid, but turn yellow to orange after a few days. They are approximately 0.03 in or 0.3 mm in diameter.

Larvae:

Newly-hatched larvae are cream colored with black heads. Mature larvae are orange to light brown and about 0.375 in or 10 mm long.

Hosts:

Monterey pine, other yellow pine species.

Damage:

- Feeding is indicated by webbing near bases of developing needles.
- Larvae feed and grow, more webbing with frass and resin becomes visible.
- Heavy infestation can result in severe malformation of trees.

Phenology:

- Four generations in southern California.
- Moth emergence begins in January.
- After mating, female moths lay up to 80 eggs singly on the new growths tips of the pine tree.
- Egg hatch occurs in about 10 to 14 days in cool weather.
- In warm weather, egg hatch occurs after only 5 to 7 days.
- Pupation occurs in growth on tips and lasts about a week during summer months.

Lure:

- Pherocon® controlled release septa.

Lure Storage:

- Store in unopened factory-sealed packages in a cool place (75° F or 23.9° C maximum).
- Refrigerate or freeze carryover stock for annual storage.

Trap Design:

- Pherocon® 1C.

Placement Time:

- Two weeks before emergence.
- Mid-January in southern California.

Placement Pattern:

- Pattern within plantation — grid pattern.
- Away from edge of field.
- 50 feet or 15.25 meters between traps to avoid competition.
- Outside of tree, or on poles between trees — 6 - 8 feet or 1.8 - 2.4 meters high.

Trap Density:

Number of traps	*Acreage*	*Hectares*
Minimum 2	< 10	< 4
Add 1 trap per 10 acres or 4 hectares	> 10	> 4

Note: Space traps at least 50 feet or 15.25 meters.

Trap Maintenance:

- Check traps daily.
- Count and remove moths, stir glue.
- Replace lures every 4 weeks.
- Plot the moth counts on graph paper to visually display generations.
- Replace liners when glue is fouled with dust or insect debris.

Recommendations: (Using traps and Degree-days):

First Generation:

- During first generation, there are generally two peaks. Second peak is critical.
- Accumulate degree-days from bio-fix to 1033 D° F or 573 D° C (approx. first peak).
- To find treatment date for first generation start counting D° from second peak until 200 D° F or 111 D° C are reached.
- Reset D° to zero.

Subsequent Generations:

- Generations 2 - 4 have only one peak.
- Determine bio-fix for generations 2 and 4.
- Second generation emergence usually in early April.
- Start accumulating D° for each successive day after bio-fix until a total of 1033 D° F or 573 D° C is reached.
- Determine treatment date by accumulating an additional 200 D° F or 111 D° C.
- There is a range of several days on either side of this date when effective control can be expected.

Recommendations: (Using only traps):

First Generation -
Spray 10 days after peak, following warm winter, or 14 days after peak following cold winter.

Second to Fourth Generations -
Spray 4 - 5 days after peak in warm summer, or 6 - 7 days after peak in cold summer.

Alternative Recommendations:

- Spray for thorough coverage, and pay particular attention to the tops of trees.
- Spray each generation once with registered insecticide at recommended label rates.
- Shear and shape trees only between peaks in moths flights.
- Remove and destroy clippings.
- Keep trees well watered and stress free.

Never

- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Description:

Adults:

Moths have irregular silver gray and black patterns on the forewings and legs and a small, snoutlike projection formed by a pair of palps in front of the head. Females begin laying on mummy nuts or new crop nuts two nights after emergence.

Eggs:

Opaque white when first laid. After about a day they turn pink, then reddish orange.

Larvae:

Newly hatched larvae are reddish orange, varying from milky white to pink upon maturing, with a pair of crescent-shaped marks on the second segment behind the head.

Hosts:

Almonds, pistachios.

Damage:

Almonds and Pistachios

- Worms do not damage sound nuts until hulls begin to split.
- Larvae consume most of nut, producing large quantities of webbing and frass.
- Damage can lead to fungal infections.
- Later maturing varieties are more susceptible.

Walnuts

- Worms do not damage sound nuts until husks begin to split.
- Will infest nuts previously damaged by codling moth or blight.
- Nuts infested solely by navel orangeworm show no external symptoms.
- Heavily infested nuts have an oily appearance.

Phenology:

- Overwinters as larva in mummy nuts in trees or on ground; usually does not enter diapause.
- Emerges in late March to early April.
- Earliest emergence is March 24.

Trap Design:

- Pherocon® IV black oviposition trap.

Lure:

- Pherocon® IV bait with 10% crude almond oil by weight.

Placement Time:

Almonds and Pistachios

• No later than April 1.

Walnuts

• Place in orchards July 1 to monitor third time (damaging) generation.

Placement Pattern:

• Within orchard — grid pattern.

• Within tree — 5 - 7 feet or 1.5 - 2.1 meters high; north side.

• Flag location.

Trap Density:

• Minimum 5 traps per block (40 acres or 10 hectares).

• One trap per added 20 acres or 5 hectares for block > 40 acres or 10 hectares.

Trap Maintenance:

• Check twice each week.

• Replace bait every 4 weeks, or when wet.

• Fill to top of window.

• Keep bait dry.

Egg/Trap Relation:

Walnuts

• Watch for egg laying at hull split.

• Check twice each week to catch eggs before hatch.

• Time harvest decisions based on eggs per trap, per day:

Almonds and Pistachios

• Beware of first minor egg flush approximately between April 1 - 15.

• Clean off eggs found to April 15 (or until consistent egg laying is observed).

• Find eggs in rough area of trap.

• Fertile new eggs are creamy white, then darken in 3 - 4 days to pink, then to red-orange.

• Larva visible 1 - 2 days prior to hatch.

Recommendations:

Almonds and Pistachios — Spring Timing

- Start timing when consistent increase in egg laying is observed.
- Remove bait from 3 - 4 traps.
- Circle eggs with wax pen.
- Hang in varied locations.
- Watch for hatch, about 10 days. Spray at hatch.
- Continue monitoring and graphing other traps.
- Time PTB/NOW sprays on NOW.
- Follow University of California mite guidelines.
- Monitor through harvest - spray at hull split if necessary.
- Hull split is when hull split begins on sound nuts in the tops of trees.

Almonds, Pistachios and Walnuts — Mid-Season Timing

WEEKS TO HARVEST:

After hull split	Consider early harvest if NOW egg/trap/day* greater than:
< 2	4.5
2-3	2.5
3-4	0.5
> 4	0.1

**** From July 1 to hull split***

Recommendations:

- Harvest guidelines should be based on:
  - Egg laying pressure
  - Historical damage levels
  - Tonnage
  - Price
- Follow good orchard sanitation.
- Control codling moth and blight.
- Follow University of California mite guidelines.

Never

- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Description:

Adults:

Tan in color, with alternating light and dark brown (oblique) bands across their forewings. Female moths are larger and more distinctively marked.

Eggs:

Dull, greenish yellow eggs are laid in flattened, overlapping masses of up to 200 on leaves. Egg mass is approximately 0.8 by 3 in or 3 by 12 mm in diameter.

Larvae:

Fully-grown larvae are 0.75 - 1 in or 19 to 25.4 mm long, yellowish green with brown to black head capsule.

Host:

Apples, pears, walnuts, filberts, pistachios, stone fruit, oaks, berries, grapes, hops, azaleas.

Damage:

- Larvae from overwintering generation become active in March and April, feeding on leaves and developing fruit.
- Severely damaged fruit or clusters are often aborted by trees. Those remaining are deeply scarred and deformed.
- Summer generation larvae cause the most serious damage by shallow feeding in the skin (0.06 inch or 0.016 mm deep) or small holes near the stem end of the fruit.
- In hazelnuts, the second generation can cause nut drop by feeding on the shell of the developing nut.

Phenology:

- Two to three generations per year (in hazelnuts only two generations).
- Overwinters as third instar larvae in hibernacula in bark crevices.
- Adult emerges in mid-May in warmer regions, mid-June in cooler districts.
- Earliest emergence is May 15 (Hood River, OR), June 1 (Yakima, WA).

Life Stages/Degree-Days:

Life Stage	*Average D° F*	*Average D° C*
Threshold temps:	43° F and 85° F	6° C and 29.4° C
First Moth Bio-fix:	930 - 980	516 -544
Reset D° to zero		
Peak Moth Flight: (post bio-fix)	210	116.6
First Egg Hatch: (post bio-fix)	420	231
First Moth 2nd Flight: (post bio-fix)	1320	732.6
First Egg Hatch: (post bio-fix)	1895	1051.7

(Threshold temps: 43 and 85° F or 6 and 29.4° C)

Lure:
• Pherocon® controlled release septa.

Lure Storage:
• Store in unopened factory-sealed packages in a cool place (75° F or 23.9° C maximum).
• Refrigerate or freeze carryover stock for annual storage.

Trap Design:
• Pherocon® 1C trap.

Placement Time:
• One to two weeks before emergence.
• May 1 - May 10 (7 - 10 days post petal fall in apples).
• Usually early June to mid-July in hazelnuts.

Placement Pattern:
• Pattern within orchard - grid pattern.
• Within tree — 6 feet or 1.8 meters high, in canopy.
• Three rows in from edge.

Trap Density:
• One trap every 10 acres or 4 hectares.
• Hazelnuts: Use one trap for every 5 acres or 2 hectares.

Trap Maintenance:
• Check 2 - 3 times per week.
• Replace lures every 5 weeks.
• Replace liners every 6 weeks or when dirty.

Recommendations:
(Using only Pherocon 1C traps):
First Generation:
• Spray 10 days after peak following warm winter, or 14 days after peak following cold winter.

Second - Fourth Generations:
• Spray 4 - 5 days after peak in warm summer, or 6 - 7 days after peak in cold summer.
• Use trap counts for detection of adult emergence.
• Alternatively, treat when capture at peak of flight meets or exceeds 20 moths per trap per week.
• Continue to monitor for second flight.

Alternative Recommendations:

- Spray for thorough coverage, and pay particular attention to the tops of trees.
- Spray each generation once with registered insecticide at recommended label rates.
- Sample 100 fruit clusters from upper third of canopy at bud stage for larvae.
- Treat if two or more larvae are found in 100 buds in springtime, four or more in summer.
- For the larval stage in hazelnuts treat when 20 - 25% of samples are infested.
- There is a range of several days on either side of this date when effective control can be expected.
- Shear and shape trees only between peaks in moths flights.
- Remove and destroy clippings.
- Keep trees well watered and stress free.

Source: Recommendations and certain other sections were sourced from University of California "Integrated Pest Management for Peaches and Nectarines."

Never

- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Description:

Adults:

Looks much like medfly except for a small dark spot on the end of the wings and a small white triangle on the metathorax.

Eggs:

Long and white. Eggs are laid singly under skin in olive tissue.

Larvae:

Typical maggot.

Distribution:

Widely distributed in Europe and the Mid East where olives are grown. Especially important in areas which have moderate temperatures and high humidity.

Damage:

- Females oviposit under the epidermis of the fruit and larvae develop inside fruit. Damage can reach 100% in the fall if high populations are present.
- Damaged fruit often drop from the tree and are smaller in size. And if there is over a 20% infestation, oil quality is decreased.
- Infested fruit must be culled if it is used for canning.
- Although flies can attack fruit early in the season, most of the damage is caused by the fall generation which occurs in October in most areas.

Phenology:

- In Spain, olive fly produces two or three generations per year depending on climatic conditions.
- In Crete, Greece, olive fly is active year round, but there are three peaks of activity: Spring, June/July and Autumn, with the Autumn flight being most important.

Lure:

- Pherocon® controlled release septa.

Lure Storage:

- Store in refrigerator or freeze in unopened factory-sealed packages.

Trap Designs:

- Pherocon® AM/NB, Pherocon® II or Pherocon® 1C.

Placement Time:

- In Spring or early Summer before olives reach sufficient size for oviposition.
- In Crete, Greece this is in late May.

Placement Pattern:

- On southwest side of tree, 8 feet or 2.4 meters high in the middle of the canopy and tangential to it.

Trap Density:

- Place traps 165 feet or 50 meters apart.
- Grid pattern.

Trap Maintenance:

- Change lure every two weeks.

Recommendations:

- Use lure and kill (bait sprays), beginning when pheromone traps indicate renewed sexual activity in spring and before olives reach sufficient size for oviposition.
- Sprays baited with sex pheromone are not disruptive to beneficial insects.
- Some indication that flies can be controlled by mass trapping with one trap per tree.

Never

- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Description:

Adults:

Adults are about 0.5 in or 13 mm long with a characteristic dark proboscis, formed by labial palpi, extending forward from the head. Color varies from dark coppery brown to almost gray. When at rest the wings form a bell-shaped outline with the basal portion of the wings being darker than the apical portion.

Eggs:

Eggs are green, flattened and overlapped like fish scales. They are deposited on either fruit or foliage in masses of 20 to more than 100. After hatching egg masses appear as a silvery deposit.

Larvae:

The larval head capsule and prothoracic shield are light brown in the first instar, black or brownish black in the second and third instar and again becomes brownish in the later instars. Larval color ranges from tan to dark green with characteristic slightly convex, chalky-white tubercles with setae, along 2 rows along the back.

Pupae:

Initially, pupae are creamy white but turn brown before adult emergence.

Hosts:

Many vines, fruits and nuts. This pest also feeds on row crops such as cotton, alfalfa, vegetables, and many species of ornamental and weed hosts.

Distribution:

A major pest in central and northern California. Also found in Arizona, Florida, Illinois, Massachusetts, Michigan, Texas, Virginia, and Washington D.C. In the midwest, it is primarily a pest in greenhouses. It is also present in northern Mexico.

Damage:

- Grapes: Larvae feed on grape flower clusters early in the season. After fruit set they feed on berries often injuring the rachis or laterals which can kill parts of clusters. As berries ripen, rot organisms invade feeding sites on berries.
- Fruits: Larvae feed on both leaves and fruit. Feeding on fruit is typically shallow, often around the stem end which causes cullage. Feeding sites are also entry sites for rot organisms.

Phenology:

- Overwinters mainly as later instar larvae in mummified fruit or in trash on the ground or on weed hosts.
- Larvae complete development in Spring, pupate and adults emerge in early Spring, usually late February or early March.
- Developmental thresholds: 48° F or 6.7° C ; it takes approximately 1240 D° F or 688 D° C for OLR to develop a complete generation.

Lure:

- Pherocon® controlled release septa.

Lure Storage:
- Store in unopened factory-sealed packages in a cool place (75° F or 23.9° C maximum).
- Refrigerate or freeze carryover for annual storage.

Trap Design:
- Pherocon® 1C.

Placement Time:
- In orchard or vineyard one week before emergence of overwintered adults.
- In the San Joaquin Valley place traps before February 20.

Placement Pattern:
- In orchard or vineyard: In grid pattern throughout orchard and vineyard.
- Within tree: 6 - 7 feet or 1.8 - 2.1 meters high in north or northeastern quadrant.
- In vineyard: Hang in open area in weak or missing vines.

Trap Density:
- One per 5 acres or 2 hectares.

Trap Maintenance:
- Check once each week.
- Change lures monthly.
- Change liner monthly or when dirty or after catching 200 moths.

Recommendations:
- Use trap counts to chart generation development and when to visually monitor bunches in grapes for larvae.
- Use to schedule cultural operations and harvest or to predict infestation by newly emerging generations.
- Preliminary information suggests best treatment timing is 500 - 700 D° F or 277 -388 D° C after the beginning of the first flight in grapes.

Supplemental Monitoring In Grapes
- Select 10 clusters from 20 marked vines beginning soon after cluster formation.
- Examine clusters on marked vines for evidence of larval infestation.
- Treat if it appears that over 10% of the clusters will be damaged at harvest.

Never
- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Description:

Adults:

At rest, wings are bell shaped. Females are orange-brown to buff colored and sometimes have V-shaped darker colored markings on the forewing. Males are somewhat smaller and have V-shaped darker colored markings with crescent shaped markings on the wing margins.

Eggs:

Deposited on smooth surfaces in clusters of up to 200, which resemble fish scales. Cream or green colored at first, but darken as they mature.

Larvae:

Head and thoracic shield are straw colored. Bodies straw colored to greenish. Tend to form protective webbings, which they leave to feed on the fruit.

Pupae:

Pupate where they feed in thin cocoon. Pupae are initially cream colored, but turns brown almost immediately.

Hosts:

Larvae have been found on at least 82 species of plants. Primarily economic problem on fruits such as apple, pear, apricot, plum, prune, citrus, grape, caneberry, and strawberry. Also found on numerous non-crop hosts, such as willow, eucalyptus, pigweed, lambsquarter, blackberry, goldenrod, mustards, filaree, lupine, mallow, curly dock, coyote brush and California poppy. Non-crop hosts act as reservoir for parasites.

Distribution:

Present along the Pacific coast from Washington to Baja, Mexico. Generally more of a pest in areas with cooler maritime climate.

Damage:

- Grapes: Feeds on swelling and newly emerged buds. Moves to clusters as they begin to form. Feeds on berries and cluster stems, which cause parts below the injury to die. Later larval feeding sites allow bunch rot organisms to develop and entire bunches are unmarketable.
- Apples & Pears: Prefer upper parts of the tree. Primarily a leaf feeder, but can cause severe damage to fruit.
- Cane Berries: Feed on both fruit and leaves.

Phenology:

- Overwinter in various larval stages.
- Larvae begin feeding in grapes and cane berries at budbreak.
- Generally not found in deciduous fruits until June.
- In California: Three generations per year in central California coastal regions and 2 to 3 generations elsewhere in its range. In California moth flights occur at three distinct times: April, July, and mid-September.

Life Stages/Degree-Days:

Life Stage	*Average Degree-Days*	*Degree-Days from Bio-fix*
Preoviposition	53 F or 29.4 C	0-53 F or 0 - 29.4 C
Egg	243 F or 134.8 C	296 F or 164.3 C
Larva	654 F or 363 C	950 F or 527.2 C
Pupa	266 F or 147.6 C	1216 F or 674.9 C
Adult Female	420 F or 233 C	1636 F or 908 C

(Threshold Temps: 43° and 78° F or 6.1° and 25.5° C)

Lure:
• Pherocon® controlled release septa.

Lure Storage:
• Store in unopened factory sealed packages in a cool place (75° F or 23.9° C maximum).
• Do not carryover stock to following year.

Trap Design:
• Pherocon® 1C.

Placement Time:
• Grapes: Place in vineyards by December.
• Deciduous fruits: Place by January 1.

Placement Pattern:
• Grapes & Cane Berries: Grid pattern. Avoid covering trap with leaves or shoots. Hang in open area where vine is missing or in weak vine.
• Orchards: Grid pattern.
• Trees: In north quadrant 7 - 9 feet or 2.1 - 2.7 meters high.

Trap Density:
• One per 5 acres or 2 hectares.

Trap Maintenance:
• Check weekly or more frequently if numbers are high.
• Always stir adhesive after removing moths.
• Change lures monthly.
• Change liners monthly or when dirty.

Recommendations:

- Trap catches plus degree-days should be used to indicate optimum timing for monitoring larvae and applying insecticide treatments.
- Deciduous Fruits: In dormant periods check weeds and debris for presence of different stages.
- Chart winter flights. When activity reaches lowest point, begin accumulation of D° as soon as it resumes. When 1000 D° F or 555 D° C accumulate after flight begins in February, (usually in late May or early June) begin checking for fruit damage by inspecting 20 fruit from 15 trees in each block. Treat if damage exceeds 2% in fresh and 4% in processing fruit. Sample second generation 1000 D° or 555 D° C after the beginning of the second flight. Treat if damage exceeds 4% in fresh or 6% in processing fruit.
- Grapes: (In California) Determine low point of flight in January or February. Treat when 1050 D° F or 583 D° C have accumulated after the period of lowest activity in January or February. Time treatments for second generation 1000 D° F or 555 D° C, plus or minus 50 D° F or 28 D° C, after low trap activity in late May or early June.

Source: Recommendations and certain other sections were sourced from University of California, "Integrated Pest Management for Apples and Pears."

Never

- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Description:

Adult:

Small, greyish moths about 0.4 in or 10 mm long.

Eggs:

Eggs are disk-shaped, white to creamy in color and about 0.03 in or 1 mm in diameter. Just before hatching, the black head of the developing larvae become visible.

Larvae:

White with black head when first hatched, the maturing larvae gradually turn pink with a brown head.

Hosts:

Peaches, nectarines and quince.

Damage:

- Feeding on shoots causes typical shoot strikes or flagging.
- Small larvae enter fruit typically at stem end and feed at the center of fruit around the pit.
- Larvae exit fruit after maturity.

Phenology:

- Overwinters as mature larvae.
- Emerges in February and early March.
- Earliest emergence in California is February 10.
- Five to 6 generations per year.

Life Stages/Degree-Days:

Life Stage	*Average D° F*	*Average D° C*
Moth bio-fix to first egg hatch	193	107
Larval development	387	214.8
Pupal development	283	157.1
Average generation	96.3 ± 46	534.5 ± 25.5

(Threshold temps: 45 and 90° F or 7.2 and 32.2° C)

Lure:

- Pherocon® controlled release septa.

Lure Storage:

- Store in unopened, factory-sealed storage packages in a cool place (75°F or 23.9° C maximum).
- Refrigerate or freeze carryover for annual storage.

Trap Design:

- Pherocon® 1C.

Placement Time:
• By February 15 in California.

Placement Pattern:
• Within orchard — grid pattern.
• Within tree 6 - 7 feet or 1.8 - 2.1 meters high.
• Northern or eastern quadrant.

Trap Density:

Number of Traps	Acreage	Hectacres
Minimum of 3	< 30	< 12
1 per 10 acres or 4 hectares	30 - 80	12 - 32
1 per 15 acres or 6 hectares	> 80	.> 32

Trap Maintenance:
• Check 2 - 3 times a week.
• Remove insects and stir glue when checking.
• Replace lures every 4 to 6 weeks.
• Replace liners when fouled with dust or insect debris, or after 200 moths have been counted and removed from liner.

OFM Treatment Schedule:
First Generation
• Set first bio-fix.
• Treatment normally not recommended.

Second Generation
• Set second bio-fix.
• 920 - 1010 D° F or 511 - 561 D° C from first bio-fix.
• Treatment 500 - 600 D° F or 278 - 333 D° C from second bio-fix.

Third and Fourth Generation
• Monitor until harvest for peaks.
• If treatment is required, spray at 500 D° F or 278 D° C after bio-fix or start of flight.

Supplementary Monitoring Techniques:
• Monitor for shoot strikes early in the season.
• Monitor fruit for presence of worms with an emphasis on the final 4 weeks before harvest, as fruit begins to color.
• Pick fruit samples from tops of trees.

Source: Recommendations and certain other sections were sourced from University of California "Integrated Pest Management for Peaches and Nectarines."

Never

- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Degree-Day Table

Max Temp	*Minimum Temperatures*													
	34	36	38	40	42	44	46	48	50	52	54	56	58	60
108	24	24	25	26	26	27	28	29	30	31	31	32	33	34
106	24	24	25	25	26	27	28	29	29	30	31	32	33	34
104	23	24	24	25	25	26	27	28	29	30	31	32	33	34
102	23	23	24	24	25	26	27	28	28	29	30	31	32	33
100	22	23	23	24	25	25	26	27	28	29	30	31	32	33
98	22	22	23	23	25	25	26	27	28	29	30	30	31	32
96	21	22	22	23	23	24	25	26	27	28	29	30	31	32
94	21	21	22	22	23	24	25	25	26	27	28	29	30	31
92	20	20	21	21	22	23	24	25	26	27	28	29	30	31
90	19	20	20	21	21	22	23	24	25	26	27	28	29	30
88	18	19	19	20	20	21	22	23	24	25	26	27	28	29
86	7	18	18	19	19	20	21	22	23	24	25	26	27	28
84	16	17	17	18	18	19	20	21	22	23	24	25	26	27
82	15	16	16	17	17	18	19	20	21	22	23	24	25	26
80	14	15	15	16	16	17	18	19	20	21	22	23	24	25
78	13	14	14	15	15	16	17	18	19	20	21	22	23	24
76	12	13	13	14	14	15	16	17	18	19	20	21	22	23
74	12	12	12	13	13	14	15	16	17	18	19	20	21	22
72	11	11	11	12	12	13	14	15	16	17	18	19	20	21
70	10	10	10	11	11	12	13	14	15	16	17	18	19	20
68	9	9	9	10	10	11	12	13	14	15	16	17	18	19
66	8	8	9	9	9	10	11	12	13	14	15	16	17	18
64	7	7	8	8	8	9	10	11	12	13	14	15	16	17
62	6	6	7	7	8	8	9	10	11	12	13	14	15	16
60	5	5	6	6	7	7	8	9	10	11	12	13	14	15
58	4	5	5	5	6	6	7	8	9	10	11	12	13	
56	4	4	4	4	5	5	6	7	8	9	10	11		
54	3	3	3	3	4	4	5	6	7	8	9			
52	2	2	2	2	3	3	4	5	6	7				
50	1	1	1	2	2	2	3	4	5					

Source: University of California, Division of Agriculture & Natural Resources

Lower Threshold: 45˚ F or 7.2˚ C
Upper Threshold: 90˚ F or 32.2˚ C

62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92
35	36	37	38	38	39	40	41	42	42	43	44	44	45	45	45
35	36	37	37	38	39	40	41	41	42	43	44	44	45	45	45
34	35	36	37	38	39	39	40	41	42	43	43	44	45	45	45
34	35	36	37	37	38	39	40	41	42	43	43	44	45	45	45
34	35	36	37	37	38	39	40	41	42	42	43	44	45	45	45
33	34	35	36	37	38	39	40	40	41	42	43	44	45	45	45
33	34	35	36	37	38	39	40	40	41	42	43	44	45	45	45
32	33	34	35	36	37	38	39	40	41	41	43	44	44	45	45
32	33	34	35	36	37	38	39	40	41	41	43	43	44	45	45
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	
30	31	32	33	34	35	36	37	38	39	40	41	42	43		
29	30	31	32	33	34	35	36	37	38	39	40	41			
28	29	30	31	32	33	34	35	36	37	38	39				
27	28	29	30	31	32	33	34	35	36	37					
26	27	28	29	30	31	32	33	34	35						
25	26	27	28	29	30	31	32	33							
24	25	26	27	28	29	30	31								
23	24	25	26	27	28	29									
22	23	24	25	26	27										
21	22	23	24	25											
20	21	22	23												
19	20	21													
18	19														
17															

Source: University of California, Division of Agriculture & Natural Resources

Description:

Adults:

Adults feature a buff or tan color with darker tan or brown band oblique across middle of wing. A narrow light tan to yellow line separates the central band from the lighter colored remainder of the wing.

Eggs:

Light green in color, Pandemis eggs are laid in clusters on upper leaf surface. After about 10 days, eggs turn greenish as they near begin to hatch about 14 days after being laid.

Larvae:

Fully grown larvae are 0.5 - 0.75 in or 12 - 19 mm long and green with head capsule ranging from green to light tan. The summer generation larvae are present from late June or early July to mid August. Moths emerge again during August and early September and larvae overwinter under the bud scales.

Host:

Apples.

Damage:

- Newly emerged larvae feed on leaf tissue.
- Overwintered larvae feed on flower buds and on the surface of young fruit during and just after bloom, causing fruit to drop or to become scarred and distorted.
- Summer generation larvae tie leaves to fruit and cause small shallow (0.0625 in or 1.5 mm) feeding scars, usually producing several small, circular holes in the fruit.
- Late season damage at harvest is difficult to detect because the pinhole entry site is fresh and usually beneath attached leaf.

Phenology:

- Two generations per year.
- Overwinters as young larvae in hibernacula in rough bark, pruning cuts or twig crotches.
- Pupation occurs in May.
- Adults emerge in late May to early June.

Life Stages/Degree-Days:

Life Stage	*Average D° F*	*Average D° C*
First moth bio-fix (from Jan.1)	930 - 980	516 - 544
Reset	D° to zero	
Peak Moth flight: (post bio-fix)	200 - 220	111 - 122
First Egg Hatch: (post bio-fix)	420 - 450	231 - 250
First Moth 2nd Flight: (post bio-fix)	1350	750
First Egg Hatch: (post bio-fix)	1900	1055

(Threshold temps: 41 and 85° F or 5 and 29.4° C)

Trap Design:
• Pherocon® 1C trap.

Lure:
• Pherocon® controlled release septa.

Lure Main:
• Store in unopened factory-sealed packages in a cool place (75° F or 23.9° C maximum).
• Refrigerate or freeze carryover stock.

Placement Timing:
• 7 - 10 days post petal fall in apples.
• Approximately May 1 - May 10 or January 1 plus 850 D° F or 471.7 D° C.

Placement Pattern:
• Pattern within orchard — grid pattern.
• Within tree — 6 feet or 1.8 meters high, in canopy.
• Three rows in from edge.

Trap Density:
• One trap every 10 acres or 4 hectares.

Trap Maintenance:
• Check 2 - 3 times per week.
• Replace lures every 5 weeks.
• Replace liners every 6 weeks or when dirty.

Recommendations:
• Pest management recommendations target either adults or larvae. First generation control is generally more successful.

First Generation Adult Control:
• Treat at peak moth flight for adult control.
• Approximately 200 - 220 D° F or 111 - 122 D° C after bio-fix (Mid June).

First Generation Larval Control:
Using a Conventional Long Residual Insecticide:
• Treat at 420 - 450 D° F or 231 - 250 D° C after bio-fix.

Using a Short Residual Insecticide:
• Treat at 420 - 450 D° F or 231 - 250 D° C after bio-fix.
• Repeat treatment at 580 - 600 D° F or 322 -333 D° C after bio-fix.

Recommendations:

Second Generation Adult Control:

• Treat at peak moth flight at 1800 D° F or 999 D° C after spring (1st moth) bio-fix.

Second Generation Adult Control:

Using a Short Residual insecticide.

• Treat at 1900 D° F or 1055 D° C after spring bio-fix.

• Repeat treatment at 2100 D° F or 1166 D° C after spring bio-fix.

Never

• Use more than one lure per trap
• Fail to count as recommended
• Fail to record trap counts
• Fail to change liners when needed
• Fail to change lure as recommended
• Discard lures within field
• Fail to follow recommendations

Description:

Adults:

These steel-gray mottled moths feature long, narrow and lightly fringed forewings. Hindwings are lighter gray and more heavily fringed. Moths are 0.3 - 0.4 in or 8 - 10 mm long.

Eggs:

They are bluntly oval in shape and yellow white to orange in color.

Larvae:

Newly-hatched larvae cap almost white with a distinct black head. As they mature, peach twig borer larvae become chocolate brown with alternating dark and light bands around abdomen. Mature larvae are about 0.5 in or 12 mm long.

Hosts:

Almonds, and stone fruits.

Damage:

• Peach twig borer damage stone fruit by feeding in shoots, causing shoot strikes, or feeding directly on fruit.

• Larvae generally enter fruit at the stem end and feed just below the skin.

Phenology:

• Overwinters as first or second instar larvae in hibernacula bored under bark at limb crotches.

• Male moths emerge in late March and April.

• Earliest known emergence in California: March 24.

• Three to four generations a year.

Life Stages/Degree-Days:

Life Stage	*Average D° F*	*Average D° C*
Bio-fix to first egg hatch:	220	122
Larvae complete:	507	281
Pupae complete:	333	149
First Generation:	1060	588

(Threshold temps: 50 and 88° F or 10 and 31.1° C)

Lure:

• Pherocon® controlled release septa; Pherocon® PTB L2™

Lure Storage:

• Store in unopened factory-sealed packages in a cool place (75° F or 23.9° C maximum).

Caution: Do not carryover.

Trap Design:

• Pherocon® 1C.

Placement Time:

- March 10 (Southern San Joaquin Valley).
- March 15 (Northern San Joaquin Valley).

Placement Pattern:

- Within interior of orchard — grid pattern.
- Within tree 6 - 7 feet or 1.8 - 2-1 meters high; NE quadrant.

Trap Density:

Number of traps	*Acreage*	*Hectacres*
Minimum 2	< 10	< 4
1 per 10 acres or 4 hectares	11 — 100	4 — 40
1 per 20 acres or 8 hectares	> 100	> 40

Trap Maintenance:

- Check 2 to 3 times each week.
- Remove insects and stir glue when checking.
- Replace standard lures every 4 weeks. Replace Pherocon® L2™ lures every 12 weeks.
- Replace liners when fouled with dust or insect debris, or after 150 moths have been counted and removed from liner.

Recommendations:

- Check traps frequently until bio-fix.
- Accumulate degree-days; monitor twice weekly.
- Spray at 400 - 500 D° F or 222 - 278 D° C from beginning of first flight.
- Continue monitoring for second flight. If necessary make a second application at 400 D° F or 222 D° C after second flight bio-fix.

Supplementary Monitoring Techniques:

- Monitor for shoot strikes on new growth in mid-March.
- Monitor fruit for presence of worms.

Source: Recommendations and certain other sections were sourced from University of California "Integrated Pest Management for Peaches and Nectarines."

Never

- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Degree-Day Table

Max Temp	*Minimum Temperatures*												
	36	38	40	42	44	46	48	50	52	54	56	58	60
118	21	22	22	23	23	24	24	25	26	27	27	28	29
116	21	22	22	23	23	24	24	25	26	27	27	28	29
114	21	21	22	22	23	23	24	25	26	27	27	28	29
112	21	22	22	23	23	24	24	24	25	26	27	28	29
110	20	21	21	22	22	23	23	24	25	26	24	28	28
108	20	20	21	21	22	22	23	24	25	26	27	27	28
106	20	20	21	21	22	22	23	24	24	25	26	27	28
104	19	20	20	21	21	22	22	23	24	25	26	27	28
102	19	19	20	20	21	21	22	23	24	25	26	27	27
100	19	19	19	20	20	21	22	22	23	24	25	26	27
98	18	19	19	19	20	21	21	22	23	24	25	26	27
98	18	19	19	19	20	21	21	22	23	24	25	26	27
96	18	18	19	19	20	20	22	23	23	24	25	26	27
94	17	18	18	18	19	20	20	21	22	23	24	25	26
92	17	17	17	18	18	19	20	20	21	22	23	24	25
88	15	16	16	16	17	18	18	19	20	21	22	23	24
86	4	15	15	15	16	17	17	18	19	20	21	22	23
84	13	14	14	15	15	16	16	17	18	19	20	21	22
82	12	13	13	14	14	15	15	16	17	18	19	20	21
80	11	12	12	11	14	14	15	16	17	18	19	20	21
78	11	11	11	12	12	13	13	14	15	16	17	18	19
76	10	10	10	11	11	12	12	13	14	15	16	17	18
74	9	9	9	10	10	11	11	12	13	14	15	16	17
72	8	8	8	9	9	10	10	11	12	13	14	15	16
70	7	7	8	8	8	9	9	10	11	12	13	14	15
68	6	6	7	7	7	8	8	9	10	11	12	13	14
66	5	6	6	6	6	7	7	8	9	10	11	12	13
64	4	5	5	5	5	6	6	7	8	9	10	11	12
62	4	4	4	4	5	5	5	6	7	8	9	10	11
60 3	3	3	3	4	4	4	5	6	7	8	9	10	
58 2	2	2	3	3	3	3	3	4	5	6	7	8	
56 1	2	2	2	2	2	2	3	4	5	6			
54 1	1	1	1	1	1	2	2	3	4				
52 0	0	0	0	0	1	1	1	2					
50 0	0	0	0	0	0	0	0						
48 0	0	0	0	0	0	0							

Source: University of California, Division of Agriculture & Natural Resources

Lower Threshold: 55˚ F or 12.8˚ C

Upper Threshold: 88˚ F or 31.1˚C

62	64	66	68	70	72	74	76	78	80	82	84	86	88	90
30	31	31	32	33	34	34	35	36	36	37	37	38	38	38
30	31	31	32	33	34	34	35	36	36	37	37	38	38	38
30	31	31	32	33	34	34	35	36	36	37	37	38	38	38
30	30	31	32	33	34	34	35	36	36	37	37	38	38	38
29	30	31	32	33	34	35	36	36	37	37	38	38	38	38
29	30	31	32	32	33	34	35	35	36	37	37	38	38	38
29	30	31	31	32	33	34	35	35	36	37	37	38	38	38
29	30	30	31	32	33	34	34	35	36	37	37	38	38	38
28	29	30	31	32	33	34	34	35	36	37	37	38	38	38
28	29	30	31	32	32	33	34	35	36	36	37	38	38	38
28	29	30	30	31	32	33	34	35	36	36	37	38	38	38
28	29	30	30	31	32	33	34	35	36	36	37	38	38	38
28	29	30	31	32	33	33	34	35	35	36	37	38	38	38
27	28	29	30	31	32	33	34	35	35	36	37	38	38	38
26	27	28	29	30	31	32	33	34	35	36	37	37	38	38
25	26	27	28	29	30	31	32	33	34	35	36	37	38	
24	25	26	27	28	29	30	31	32	33	34	35	35		
23	24	25	26	27	28	29	30	31	32	33	34			
22	23	24	25	26	27	28	29	30	31	32				
22	23	24	25	26	27	28	29	30	30					
20	21	22	23	24	25	26	27	28						
19	20	21	22	23	24	25	26							
18	19	20	21	22	23	24								
17	18	19	20	21	22									
16	17	18	19	20										
15	16	17	18											
14	15	16												
13	14													
12														

Phenological information under validation by the University of California researchers.

Source: University of California IPM project.

Description:

Adults:

Moths are gray to almost black, and about 0.33 in or 8.4 mm long. They are only active at night when mating and egg laying occur. Females will lay about 50 to 150 eggs during their 5 to 6 day lives.

Eggs:

Eggs are flat, oval and very small in size, but still able to be seen with the naked eye. They are greenish-white to white when first laid. Tiny red spots will appear, giving the egg a pink color. Eggs require about 4 days to hatch.

Larvae:

Larvae appear as olive-gray to jade green in color, and will reach an approximate length of 0.50 in or 12.5 mm long.

Hosts:

Pecans.

Distribution:

Found in all major pecan growing areas from New Mexico to Georgia.

Damage:

- Larvae will feed on the buds for approximately 2 days after hatching before moving into the nutlets. Larvae will tunnel into the nutlets, often destroying the entire cluster.

Phenology:

- 2 - 4 generations per year.
- Overwinters as a first instar larvae in hybernaculum on pecan twigs.
- Adults of overwintering generation emerge and lay eggs in spring (April and May).
- Eggs of overwintering generations are laid on nutlets.
- 2nd generation larvae attack nutlets about 6 weeks after 1st generation nut entry.
- 3rd generation emerges from late July to early September.

Lure:

- Pherocon® controlled release septa.

Lure Storage:

- Store unopened factory-sealed foil packages in a cool place (75° F or 23.8° C maximum).
- Refrigerate or freeze carryover stock for annual storage.

Trap Design:

- Pherocon® 1CP, Pherocon® II or Pherocon® III Delta.

Placement Pattern:
- Traps should be placed within the orchard, and hung from a tree.
- Trap height should be convenient, no less than 6 - 8 feet or 1.8 - 2.4 meters.
- Place a minimum of 100 feet or 33.3 meters apart.

Trap Density:
- On larger uniform plantings, one per 10 acres or 4 hectares.
- Minimum of 3 traps for any planting.

Trap Counting:
- For optimum use results, traps should be checked each day, or every other day.
- Minimum checking: 2 to 3 times a week.

Trap Recording:
- Pest managers should place trap count information on graph paper to better view emergence pattern.
- Keep careful records/files of trap count information, including graphs. The history and control measures are invaluable when checking the current year requirements for control.

System Maintenance:
- Change lures at 4 to 5 week intervals.
- Change Pherocon® 1CP liners or Pherocon® II and Pherocon® III Delta traps at 4 to 6 week intervals, or when dirty.
- Dispose of used lures and liners outside of the orchard.

Recommendations:
- Begin scouting for PNCB eggs about 7 - 12 days after the first PNCB moths are captured in each generation.
- Be sure to change lures and liners at the end of the 1st flight preceding the 2nd flight.
- See your local extension service recommendations for egg/larvae treatment thresholds.

Never
- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Description:

Adults:

Male's scale covering is gray enlongated with distinct knob near larger end. Female's covering remains circular. Males molt a total of four times, then yellowish winged adults emerge to mate with females. Females sessile under gray circular shell covering. Body of adult female is yellow under its covering.

Crawler stage:

Female San Jose scale give birth to living young that emerge from under scale covering. The bright yellow crawler is about the size of a pin and resembles a mite. After leaving the protection of the female, it relocates by crawling.

White cap stage:

Upon settling, crawlers insert mouthparts into host plant and begin feeding and secreting a white waxy material.

Black cap stage:

Eventually, waxy covering turns black.

Hosts:

Peaches, nectarines, plums, pears, apples, almonds, prunes, walnuts.

Damage:

- San Jose scale feed on twigs, branches, and fruit; they may also inject salivary toxins while feeding.
- Heavy populations may cause gumming and kill twigs, branches and entire trees.

Phenology:

- Emerges in mid February to mid March.
- Earliest emergence in California: February 24.

Life Stages/Degree-Days:

Life Stage	*Average D° F*	*Average D° C*
Mating to crawler	405	224.8
Crawler to first instar	318	176.5
Second instar	213	118
Pupae (male)	95	52.7
Pre-mating	19	10.5
Full Generation	1050	583

(Threshold temps: 51 and 90° F or 10.5 and 32.2° C)

Lure:

- Pherocon® controlled release septa.

Lure Storage:

- Store unopened factory-sealed foil packages in a cool place (75° F or 23.9° C max.)
- Refrigerate or freeze carryover stock for annual storage.

Trap Design:
• Pherocon® V or tent trap.

Placement Time:
• Mid-February in mid-state orchards.

Placement Pattern:
• Within orchard — grid pattern.
• Within tree — 6 - 8 feet or 1.8 - 2.4 meters high; center of canopy.
• Male scale are very weak fliers, optimum trap placement is in trees with known history of infestation.

Trap Density:

Number of traps	*Acreage*	*Hectacres*
Minimum 4	< 10	< 4
3 - 4 per 10 acres or 4 hectares	11 - 100	4.4 - 40

Trap Maintenance:
• Check 2 - 3 times per week until bio-fix; 1 - 2 times per week thereafter.
• Replace liners at every counting when insects are present or fouled with dust.
• Replace lures every 4 to 6 weeks.

Recommendations:
• Apply dormant spray.
• Check traps frequently until bio-fix.
• Accumulate degree-days; monitor twice weekly.
• Spray at 600 - 700 D° F or 333 - 388.5 D° C, or from beginning of first flight recorded in trap.
• Spray at 200 to 300 D° F or 111 - 166.5 D° C, or from crawler emergence recorded on sticky tape.

Supplementary Monitoring Techniques:
• Monitor prunings for scale during the dormant period. Look for gummy ooze, roughened bark, or dead leaves sticking to fruit spurs.
• Use double-sided sticky tape on scaffold limbs to catch males that crawl rather than fly to females.
• Check fruit at harvest for scale or scale marks.

WARNING: Must use scaffold tape or observation for first flight experiencing consistent rain, cold, windy weather— near bio-fix.

Source: Recommendations and certain other sections were sourced from University of California "Integrated Pest Management for Almonds."

Never

• Use more than one lure per trap
• Fail to record trap counts
• Fail to change lure as recommended
• Fail to count as recommended
• Fail to change liners when needed
• Discard lures within field

Degree-Day Table

Max Temp	*Minimum Temperatures*												
	34	36	38	40	42	44	46	48	50	52	54	56	58
118	21	22	22	22	23	23	24	24	25	26	27	28	28
116	21	21	22	22	23	23	24	24	25	26	27	27	28
114	21	21	21	22	22	23	23	24	25	25	26	27	28
112	20	21	21	22	22	22	23	24	24	25	26	27	20
110	20	20	21	21	22	22	23	23	24	25	26	27	28
108	20	20	20	21	21	22	22	23	24	25	25	26	27
106	19	20	20	21	21	21	22	23	23	24	25	26	27
104	19	19	20	20	21	21	22	22	23	24	25	26	27
102	19	19	19	20	20	21	21	22	23	23	24	25	26
100	18	18	19	19	20	20	21	21	22	23	24	25	26
98	18	18	18	19	19	20	20	21	22	23	24	24	25
96	17	17	18	18	19	19	20	20	21	22	23	24	25
94	17	17	17	18	18	19	19	20	21	21	22	23	24
92	16	16	17	17	17	18	19	19	20	21	22	23	24
90	15	15	16	16	17	17	18	18	19	20	21	22	23
88	14	15	15	15	16	16	17	17	18	19	20	21	22
86	13	14	14	14	15	15	16	16	17	18	19	20	21
84	12	13	13	13	14	14	15	15	16	17	18	19	20
82	11	12	12	12	13	13	14	14	15	16	17	18	19
80	11	11	11	12	12	12	13	13	14	15	16	17	18
78	10	10	10	11	11	11	12	12	13	14	15	16	17
76	9	9	9	10	10	10	11	11	12	13	14	15	16
74	8	8	8	9	9	9	10	10	11	12	13	14	15
72	7	7	8	8	8	9	9	9	10	11	12	13	14
70	6	6	7	7	7	8	8	8	9	10	11	12	13
68	5	6	6	6	6	7	7	8	8	9	10	11	12
66	5	5	5	5	5	6	6	7	7	8	9	10	11
64	4	4	4	4	5	5	5	6	6	7	8	9	10
62	3	3	3	4	4	4	4	5	5	6	7	8	9
60	2	2	3	3	3	3	3	4	4	5	6	7	8
58	2	2	2	2	2	2	2	3	3	4	5	6	7
56	1	1	1	1	1	1	2	2	2	3	4	5	
54	1	1	1	1	1	1	1	1	1	2	3		
52	0	0	0	0	0	0	0	0	0	1			
50	0	0	0	0	0	0	0	0	0				

Source: University of California, Division of Agriculture & Natural Resources

Lower Threshold: 51˚ F or 10.6˚ C
Upper Threshold: 90˚ F or 32.2˚C

60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90
29	30	31	32	32	33	34	35	35	36	37	37	38	38	39	39
29	30	31	32	32	33	34	35	35	36	37	37	38	38	39	39
29	30	31	31	32	33	34	35	35	36	37	37	38	38	39	39
29	29	30	31	32	33	34	34	35	36	37	37	38	38	39	39
28	29	30	21	32	33	33	34	35	36	36	37	38	38	39	39
28	29	30	31	32	32	33	34	35	36	36	37	38	38	39	39
28	29	30	31	31	32	33	34	35	35	36	37	38	38	39	39
28	28	30	30	31	32	33	34	35	35	36	37	38	38	39	39
27	28	29	30	31	32	33	33	34	35	36	37	37	38	39	39
27	28	29	30	31	31	32	33	34	35	36	37	37	38	39	39
26	27	28	29	30	31	32	33	34	35	36	36	37	38	39	39
26	27	28	29	30	31	32	33	34	34	35	36	37	38	39	39
25	26	27	28	29	30	31	32	33	34	35	36	37	38	38	39
25	26	27	28	29	30	31	32	33	34	35	36	37	37	38	39
24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	
22	23	24	25	26	27	28	29	30	31	32	33	34	35		
21	22	23	24	25	26	27	28	29	30	31	32	33			
20	21	22	23	24	25	26	27	28	29	30	31				
19	20	21	22	23	24	25	26	27	28	29					
18	19	20	21	22	23	24	25	26	27						
17	18	19	20	21	22	23	24	25							
16	17	18	19	20	21	22	23								
15	16	17	18	19	20	21									
14	15	16	17	18	19										
13	14	15	16	17											
12	13	14	15												
11	12	13													
10	11														
9															

Phenological information under validation by the University of California researchers.
Source: University of California IPM project.

Description:

Adults:

Adult moths are small, about 0.25 in or 6.35 mm long. The forewings are held roof-like over the body. Wings are golden bronze in color and have white streaks edged in black running diagonally across the forewings.

Eggs:

Laid singly on the undersides of leaves. They are small, (0.1 - 0.12 in or 2.54 to 3.0 mm in diameter), round, flat, yellowish green in color.

Larvae:

The first 3 instars (sap feeders), are flat, wedge shaped, legless and cream colored. Later instars (issue feeders) are cylindrical, have legs and are cream colored or yellow depending on the instar.

Pupae:

Cylindrical with abdominal segments that taper sharply. Light tan when newly formed to dark brown just before adult emergence.

Damage:

- Direct damage is limited to foliage. A reduction in fruit size, color and soluble solids can result if leaf damage is severe.

Distribution:

- Widely distributed throughout fruit-growing areas.

Phenology:

- California: There are at least 4 generations per year in California. Leafminers overwinter as pupae within the tissue of fallen leaves. Adults emerge as early as late February in California and in late March or early April in the northwest. Egg laying peaks at about full bloom in apple. In California, in addition to adults emerging in late February and early March, other adult flights occur in May, July and September.
- Washington: In Washington, major flight periods usually occur in April, June, August and September. The September flights produce larvae which overwinter as pupae. Many of the late larvae do not complete the larval stage before cold weather and defoliation begins and are consequently killed by cold or freezing temperatures. This is especially true in northern areas.
- Lower Developmental Thresholds: 44° F or 6.7° C.

Lure:
Pherocon® controlled release septa.

Lure Storage:
- Store in unopened factory-sealed packages in a cool place (75° F or 23.9° C maximum).
- Refrigerate or freeze carryover for annual storage.

Trap Design:
- Pherocon® 1C.

Placement Time:
- Install before adults begin emerging in early Spring, usually at pink in apples.
- In California this is usually in late February.
- In the northwest at early pink, or by April 1.
- In Michigan by March 15.
- In New York, before the beginning of the second flight, (usually by June 10).

Placement Pattern:
- In orchard: Place in 2 or 3 randomly selected trees throughout the orchard.
- Place traps at least 4 rows inside orchard.
- In tree: Hang 6 - 8 feet or 1.8 - 2.4 meters high in the northeast quadrant of the tree, just inside canopy.

Trap Density:
- A minimum of 2 per orchard.
- One per every 5 acres or 2 hectares.

Trap Maintenance:
- Check 2 or 3 times weekly, or more often if heavy flights occur.
- Replace lures every 4 weeks.
- Change liners monthly or when dirty.

Recommendations:
- Michigan: A treatment threshold for the spotted tentiform leafminer has been set at 500 per trap in any 3 day period.

Supplemental Monitoring:

New York:

• Begin leaf sampling at second generation at 630 D° F or 350 D° C. after bio-fix.

Other areas:

• Use traps to indicate when new generations are beginning so that supplemental sampling can take place. Treatment thresholds are basedon the number of miners per leaf.

Collect leaf sample during each generation and determine the number of sapfeeders per leaf.

California:

Generation	***Sample Size (leaves)***	***Treatment Threshold (sap feeding mines per leaf)***
First	50	1 and parasitism is below 35%
Second	4 from 25 trees (100)	2 and less than 10% parasitism 1st generation
Third	4 from 25 trees (100)	5 or less than 30% parasitism
Fourth	4 from 25 trees (100)	5 - 10 and parasitism below 30%

Washington:

Generation	***Sample Size (leaves)***	***Treatment Threshold (sap feeding mines per leaf)***
First	50	1 and parasitism is below 35%
Second	5 from 20 trees (100)	2 and parasitism in 1st gen below 35%
Third	5 from 20 trees (100)	If early, treat if over 5

Note: Try to time treatments for other pests to periods when adult parasites are at a low level.

Never

- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Description:

Adults:

Wide range of colors, but generally has cinnamon or reddish brown forewings with three pale whitish or grayish lines on the forewings.

Eggs:

Laid on upper side of leaf in overlapping masses resembling fish scales. Often 100 or more in each egg mass. Color greenish yellow similar to apple leaf.

Larvae:

Head and thoracic shield light brown with darker lateral spots on the thoracic shield. Body yellowish green in color.

Pupae:

Pupate at final feeding site. Greenish brown initially, but turns brown as pupae age.

Hosts:

Apple, cherry, plum, and peach. Plus, a wide range of woody plants including willow, aspen, birch, elm, dogwood, rose, strawberry, and blueberry.

Distribution:

Southern Canada, eastern and northwestern United States.

Damage:

- Prefers growing tips, worse in young orchards and nurseries.
- Early season damage to fruit causes deep scars, damaged fruit often drops.
- Shallow feeding scars on mature fruit causes the fruit to be culled.
- May or may not web leaves to fruit.
- In British Columbia larvae feed on undersides of leaf under webbing, does not roll leaves.
- In eastern U.S. young larvae often colonize rolled leaves or feeding sites from earlier feeding by other species.

Phenology:

- One generation per year in Nova Scotia and northern fruit growing areas in British Columbia.
- Two generations per year in New York and southern Okonagan Valley in British Columbia.
- Overwinters as third instar larva in hibernacula in protected places on small diameter growth.
- Resumes feeding during green tip, feed until about three weeks after apple bloom.
- Adults active from early June to mid-July and from mid-August to October.

Lure:

- Pherocon® controlled release septa.

Lure Storage:
- Store in cool place in unopened, factory-sealed packages (75° F or 23.9° C maximum).
- Refrigerate or freeze carryover stock for annual storage.

Trap Design:
- Pherocon® 1C.

Placement Time:
- Late May or early June before beginning of first flight.

Placement Pattern:
- Within orchard grid pattern throughout the orchard.
- Within tree, 6 - 9 feet or 1.8 - 2.7 meters high. Do not place in upper third of large trees.

Trap Density:
- One trap per 2.5 acres or 1 hectare.

Trap Maintenance:
- Change lures monthly.
- Replace liners at 4 to 6 weeks or when dirty or contaminated by moth scales.
- Read traps weekly or more often if flights are so heavy that traps are overloaded.

Recommendations:
- Use to indicate when moths are active.
- Use as aid to species identification.
- Generally (but not always) 15 moths or less per week per trap indicates little potential for damage.

Source: Recommendations and certain other sections were sourced from "Orchard Pest Management. A Resource Book for the Pacific Northwest."

Never
- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Description:

Adults:

White with well defined metallic blue spots on the forewings and 6 dark spots on the thorax.

Eggs:

Oval, 0.04 in or 1 mm in diameter, yellow when first laid, turning pink before hatching.

Larvae:

Mature larvae are large, 2.3 - 2.5 in or 60 - 70 mm long, yellow with black spots, with black thoracic shield and head.

Distribution:

Present in Europe, Mid East and eastern US.

Damage:

- The damage is worse in young trees. Larvae initially mine terminals which causes them to die. This makes young trees difficult to train.
- As larvae mature they bore into larger branches which can cause them to become weakened and die.

Phenology:

- Most larvae complete their development in a single year, although there is a small percentage that do not emerge until the second year.
- Overwinters in the larval stage, and adults emerge between June and September in Spain.
- Adults live 5 - 10 days and can lay up to 1000 eggs.
- Eggs hatch in 7 - 21 days and neonates enter the terminals where they feed.

Lure:

- Pherocon® controlled release septa or polyethylene string lure.

Lure Storage:

- At room temperature 68° F or 20° C for in season use and refrigerate or freeze for long term storage.

Trap Design:

- Pherocon® 1C.

Placement Time:

- Before adults begin to emerge in May.

Placement Pattern:

- Within orchard — grid pattern.
- Within tree 6 - 7 or 1.8 - 2.1 feet high.
- Northern or eastern quadrant.

Trap Density:

Number of traps	*Acreage*	*Hectares*
Minimum of 3	< 30	< 12
One per 5 acres or 2 hectares	30 - 80	12 - 32
One per 10 acres or 4 hectares	> 80	> 32

Trap Maintenance:

- Check 2 to 3 times a week.
- Remove insects and stir glue when checking.
- Replace lures every 4 to 6 weeks.
- Replace liners when fouled with dust or insect debris, or after 200 moths have been counted and removed from liner.

Recommendations:

- In young trees cut out and destroy damaged branches with larvae inside.
- In larger trees inject a mixture of oil and OPs into the galleries in the fall or spring.

Never

- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Description:

Adults:

About the size of house flies and very colorful. A yellow spot just below the area where wings are attached, and a dark triangular band at the tip of wings distinguishes this fly.

Eggs:

Eggs are deposited in groups of about 15 below the surface of the husk.

Larvae:

Eggs hatch into white maggots after about five days. Older maggots are yellow with black mouthparts. After feeding on the husk for three to five weeks, mature larvae drop to the ground and burrow into the soil to pupate.

Hosts:

Walnuts.

Damage:

- Females "sting" husks when depositing eggs.
- Maggots feed inside husk, turning it soft and black.
- Husk remains intact, fleshy parts decay and stain nutshell.
- Early infestation could lead to shriveled, darkened kernels and increased mold.
- Late infestations damage shell for in-shell sales.

Phenology:

- One generation per year.
- Adults emerge from pupae in soil generally from early July to September.
- Female emerges slightly later than male, oviposits on husks.
- Females "sting" husks when depositing eggs.
- Maggots feed inside husk, drop to ground and burrow into soil where they pupate and remain until the following summer.
- Earliest emergence is in mid to late June.

Lure:

- Pherocon® SuperchargerTM and AM/NB (yellow) trap.

Lure Storage:

- Store in cool, dry place (75° F or 23.9° C maximum).
- Do not refrigerate.

Trap Design:

- Pherocon® AM/NB.

Placement Time:

- Mid-June.

Placement Pattern:

- Pattern within orchard — grid pattern.
- Within tree — 10 - 12 feet or 3 - 3.7 meters high in shady lower interior, in cool, damp locations.

Trap Density:

Number of traps	*Acreage*	*Hectacres*
Minimum 3	< 30	< 12
One trap per 10 acres or 4 ha.	30 - 100	12 - 40
One trap per 20 acres or 8 ha.	> 100	> 40

Historically highly infested areas should be monitored with additional traps.

Trap Maintenance:

- Check at least 3 times each week.
- Count and remove flies, stir glue.
- Replace traps with superchargers every 2 weeks.
- Replace traps when glue is fouled with dust or insect debris.

Recommendations:

- Apply treatments 7 days after a sudden increase in trap catch, indicating female emergence.
- Continue monitoring after first spray to verify efficacy of first spray.

Alternative Recommendations:

- Use superchargers to detect earliest emergence.
- Start to monitor nuts for stings 2 to 3 weeks after first appearance of females in traps.
- Check a minimum of 10 nuts from shady areas of 20 vigorous trees throughout the orchard.
- Check stem end especially. Stings visible just after egg laying.
- Verify presence of eggs in stung fruit.
- Treat when egg laying begins.

Source: Recommendations and certain other sections were sourced from University of California, "Integrated Pest Management for Walnuts."

Never

- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Description:

Adults:

The adult has a black body with white bands on the abdomen. The wings are transparent with a distinctive dark banding pattern. It can easily be distinguished from other fruit flies by the wing pattern. The fly is about 0.20 in or 5 mm long. The female is slightly larger than the male.

Eggs:

The eggs are yellowish and elongated, with a stalk at one end. It is about 0.04 in or 0.8 mm long and is deposited under the cherry skin.

Larvae:

The larva is a creamy white, legless maggot, tapered at the head and blunt at the rear. It passes through three instars and grows to about 0.03 in or 8 mm long.

Host:

Cultivated and wild cherries.

Damage:

• Larvae develop inside the fruit making the fruit unmarketable.

Phenology:

• One generation per year.
• Overwinters as pupa in the soil.
• Adults emerge May about 5 weeks before harvest.
• Adults are active until 3 to 4 weeks after harvest.
• Adults live 16 - 35 days, depending on temperatures.
• Adult females undergo a 7 - 10 day preoviposition period before maturity.
• Lower threshold is 41° F or 5° C.
• No upper threshold.

Lure:

• Pherocon® SuperchargerTM and AM/NB (yellow) trap.

Lure Storage:

• Store in cool, dry place (75° F or 23.9° C maximum).
• Do not refrigerate.

Trap Design:

• Pherocon® AM/NB

Placement:

• Mid-May.

Placement Pattern:

- Pattern within orchard — grid pattern.
- Within tree 10 - 12 feet or 3.0 - 3.7 meters high.

Remove fruit and foliage from around the trap for 12 - 18 in or 0.3 - 0.5 m.

Trap Density:

Number of traps	*Acreage*	*Hectares*
Minimum of 3	< 30	< 12
One per 5 acres or 2 hectares	30 - 100	12 - 40
One per 10 acres or 4 hectares	> 100	> 40

Trap Maintenance:

- Check twice each week.
- Replace lures every 5 weeks.
- Replace liners every 6 weeks or when dirty.

Recommendations:

- Use traps to confirm first fly emergence.
- Use degree-days model (unrelated to trap) to determine first spray.
- First fly expected at approximately 950 D° F or 527 D° C after March 1. Trap should confirm.
- Control sprays should be applied on or before 1060 D° F or 588° C after March.
- Repeat every 10 to 21 days depending on residual activity of product.
- Control with short residuals should be repeated every 7 days.
- Maintain control program throughout harvest.
- Post-harvest control should be applied to prevent late-emerging flies from completing their lifecycles.

Never

- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

IPM Partner Guidelines: ROW CROP INSECTS

Description:

Adults:

About 1 in or 25 mm long with mottled brown or gray front wings and lighter gray hind wings.

Eggs:

Pink to pale green eggs are laid in masses on the upper sides of leaves. Covered with white cottony material made of scales from the female moth.

Larvae:

Generally light olive green color, but may range from bright green to purplish green or almost black. A dark stripe is located on the back with yellow stripes on each side. Commonly have a black spot above the second pair of legs. Mature larvae are about 1 in or 25 mm long.

Pupae:

About 0.75 in or 20 mm long, green to dark brown in color, inside loosely woven cocoon.

Hosts:

Lettuce, cole crops, tomatoes, beans, corn, sugarbeets, cotton, alfalfa.

Distribution:

• Occurs through the west and in Hawaii. Probably introduced from Europe.

Damage:

• Primarily a foliage feeder. Can defoliate plants under some conditions. This can result in poor quality and loss of yield. Will feed on fruit of tomatoes.

Phenology:

• Four to 5 generations per year in California.

• Larvae reach maturity in 2 to 3 weeks in warm weather.

Life Stages/Degree-Days (Cotton):

Life Stage (Females)	*Average D° F*	*Average D° C*
Larvae	470	261
Pupae	318.1	177
Generation Time (Egg to Adult)	882.0	490
Life Stage (Males)	***Average D° F***	***Average D° C***
Larvae	540.0	300
Pupae	344.0	191
Generation Time (Egg to Adult)	977.9	543

(Threshold temps: Lower 54° F or 12.2° C)

Lure:
• Pherocon® controlled release septa.

Lure Storage:
• Store in unopened factory-sealed packages in a cool place (75° F or 23.9° C maximum).
• Refrigerate or freeze carryover for annual storage.

Trap Design:
• Pherocon® 1C, WT, or bucket trap.

Placement Time:
• At planting in lettuce and cole crops.
• When crops are susceptible to damage.

Placement Pattern:
• At least one in each of 4 corners of the field.
• On stake level with the top of the crop.

Trap Density:

Number of traps	*Acres*	*Hectares*
Minimum of 2 per field	----	----
One trap per 20 acres or 8 ha	> 20	> 8

Trap Maintenance:
• Check twice weekly.
• Change lures monthly.
• Change liners monthly, or when dirty.

Recommendations:
• Use pheromone traps to determine location.
• Begin intensive monitoring 7 to 10 days after the beginning of the flight.

Never
• Use more than one lure per trap
• Fail to count as recommended
• Fail to record trap counts
• Fail to change liners when needed
• Fail to change lure as recommended
• Discard lures within field
• Fail to follow recommendations

Description:

Adults:

Color varies from yellowish tan to brown, with two dark spots on each forewing. Adults feature buff colored hind wing with brown margin and transverse brown band.

Eggs:

Laid singly, on corn, almost all on silk. Hemispherical in shape, they feature prominent longitudinal ridges. The eggs are white to yellowish when first laid, developing a dark red or brown ring around the top just before hatching.

Larvae:

Newly hatched larvae are white with prominent black tubercles. Short spines protrude from each tubercle. Mature larvae are 1 - 1.5 in or 25.4 - 38 mm long. Overall color is variable — green, brown, to pink. The body is covered with short spines which can be seen with 10X hand lens. Corn earworm larvae usually develop distinct stripes that do not extend the length of the body. The head is light brown with no distinct markings.

Pupae:

Brown, 0.75 - 1 in or 19 - 25.4 mm long. Pupation is in the soil.

Distribution:

Found throughout much of the tropical and temperate regions of the world.

Hosts:

Corn earworm is a serious pest on many crops, including corn, cotton, lettuce and tomatoes. It also attacks alfalfa, artichokes, bean pods, cabbage, chick pea, clover, geranium, gladiolus, grape, hemp, henbane, malva, melilotus, millet, okra, peach, pea, peanuts, pear, pepper, pumpkin, rice, roses, squash, strawberry, sunflower, tobacco and hairy vetch.

Damage:

- Corn earwom is a seedling pest on many crops.
- Cotton bollworm: Destroys developing green bolls.
- Corn earworm: Primary damage is feeding on silk and developing ears.
- Tomato fruitworm: Feeds inside green and ripening fruit.

Phenology:

- Overwinters in the soil in pupal stage.
- Emergence can begin as early as April in warmer areas.
- Does not overwinter in northern states.
- Two to three generations per year, depending on location.

Life Stage/Degree-Days:

Life Stage	*Average D° F*	*Average D° C*
Eggs	72.9	40.5
Small larvae (1st - 3rd instars)	147.1	81.6
Large larvae (4th and 5th instars)	217.1	120.5
Pupae	323.1	179.3
Generation Time (Egg to Adult)	760	421.8
Preovoposition Adults	112.7	62.5
Generation Time	872.8	484.4

(Threshold temps: 54.7 - 91.9° F or 12.6 - 33.3° C.)

** May vary depending on larval food source*

Lure:

- Pherocon® controlled release septa.

Lure Storage:

- Store in refrigerator or freeze in unopened factory-sealed packages.
- Do not keep from year to year.

Trap Design:

- Pherocon® 1C/WT.

Placement Time: (Corn: New York)

- By late June or early July, when green silks begin to appear.

Placement Pattern:

- In edges of field or inside field 16 to 24 rows from edge.
- On windward side of field so pheromone will be blown into field.
- Bottom of traps should be suspended on stake above top of canopy.
- Place traps at least 60 - 120 feet or 20 - 40 meters apart.

Recommendations:

- For fresh market sweet corn — if pheromone traps indicate CEW is present, sample fields at least twice per week.

Procedure:

- Divide fields into 10 acre or 4 hectares sampling units.
- Walk field in "V" or "U" pattern.
- Stop at several sites and sample five consecutive plants that have an ear in the silk stage or past.
- Carefully examine tip of the ear and silk for the presence of larvae, frass or damage.
- If any sign of infestation is found, count that plant as infested.
- Sample a minimum of 5 sites.

- Use sequential sampling form for making decision.
- When more than one species is present they are additive.

Processing sweet corn:

If corn earworm damage is marketing concern, a spray program should be initiated for a given field when traps show dramatic increase in catch during period from green silking through brown silking.

Placement Time: (Tomatoes and Cotton—west)

- Tomatoes: When largest fruit reaches 1 in or 25 mm in diameter.
- Cotton: When first bolls begin to form.

Placement Pattern:

- Tomatoes: inside field. Suspend bottom of traps on stake above top of canopy.
- Cotton: Around field edges.

Trap Density:

- At least 2 per field.
- More if used to detect hot spots.

Recommendations:

Cotton and Tomatoes:

- Use to determine period of peak oviposition.
- Use to indicate when scouting or monitoring should be intensified.
- Useful for determining population trends for species.

Trap Maintenance:

- Change lures every 2 weeks.
- Add liquid to WT traps as it is lost, or change 1C liners monthly, or before if they become dirty.
- Check traps at least weekly, but preferably twice each week.
- As moth catches increase checking 3 times per week is desirable.

Source: Recommendations and other sections sourced from Cornell University's "Pheromone Traps - Effective Tools for Monitoring Lepidopterous Pests of Sweet Corn" as well as University of California's "Integrated Pest Management for Cotton" and "Integrated Pest Management for Tomatoes."

Never

- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Description:

Adults:

The adult moth is approximately 0.375 in or 9 mm long. It has a silvery color with light brown outer edges on the front wings. A silver band and small black dots are located near the outer margin of the forewing. The moth has a snout-like nose. The adult moth begins to lose its coloration shortly after emerging. Adults caught in traps often have lost most of their identifying marks and must be identified on their general shape and size.

Eggs:

The eggs are 0.02 in or 0.5 mm long. Although creamy white when first laid, the eggs turn pink within a few days and darken before hatching. Females scatter eggs randomly on the bog floor.

Larvae:

At hatching, the larva is about 0.083 in or 2 mm long and grows to 0.5 in or 13 mm before spinning a cocoon in fall. The larva has a dark brown head and a dingy white body with a scattering of hairs. It constructs a cocoon from leaf litter on the bog floor, where it changes to prepupa, thus completing the life cycle.

Hosts:

Cranberries, certain grasses, turf grasses, Douglas fir seedlings, sheep sorrel and "three square."

Damage:

- Plant injury occurs from the feeding of the larvae.
- Larvae feed on bark and wood, sometimes chewing completely through a runner.
- Girdling, or removal of the bark and inner conductive layers, interferes with transfer of moisture and nutrients in the plant and leads to its death.
- Damage might not be fully apparent until foliage turns brown and defines the damaged areas.

Phenology:

- One generation per year.
- Overwinters as prepupa inside cocoon on the bog floor.
- Cranberry girdlers pupate within their cocoons in Spring as temperatures increase.
- Pupation occurs in May and June.
- Adults emerge June and continue to fly until late July.
- Larvae begin hatching out in mid to late June.

Lure:

- Pherocon® controlled release septa.

Lure Storage:

- Store in unopened factory-sealed packages in a cool place (75° F or 23.9° C maximum).
- Refrigerate or freeze carryover for annual storage.

Trap Design:
• Pherocon® 1C trap.

Trap Density:
• Never less than two traps.
• One trap per 2.5 acres or 1 hectare.

Placement Time:
• One to two weeks before earliest known emergence.
• Beginning of June.

Trap Placement:
• Place on stakes at height of canopy.
• Grid pattern.

Trap Counting/Recording:
• Check 2 - 3 times per week.
• Record data at each checking.
• Graph information when possible to visualize peaks.

Trap Maintenance:
• Remove insects after each count and stir glue.
• Replace lures every 4 weeks.
• Replace liners every 6 weeks or when dirty.

Recommendations:
• Apply larval controls 3 to 4 weeks following peak emergence.
• Irrigate to ensure movement of insecticide into larvae feeding zone.

Never
• Use more than one lure per trap
• Fail to count as recommended
• Fail to record trap counts
• Fail to change liners when needed
• Fail to change lure as recommended
• Discard lures within field
• Fail to follow recommendations

• EXPERIMENTAL USE GUIDELINES •

Description:

Adults:

About 0.125 in or 3 mm long (ranges from 0.0625 - 0.156 in or 1.5 - 4 mm), shiny black with yellowish-white scale-like hairs. Typical weevil appearance, but 1/3 to 1/2 the size of an adult boll weevil. Males produce a potent multi-component sex/aggregation pheromone which attracts both males and females in varying ratios.

Eggs:

Eggs are generally placed individually in holes cut by females into the pepper bud or in the base of young pepper pods. Females avoid ovipositing into buds or pods already containing an egg.

Larvae:

Eggs hatch in about 3 - 5 days. Mature larvae are less than 0.25 in or 6 mm long and resemble a white grub. Larvae feed on seed core or tissue of pod wall and larval development requires about 2 to 3 weeks.

Pupae:

Pupation occurs within the pepper pod, on or in the seed receptacle (placenta), and requires about 3 to 6 days.

Host:

Peppers (Capsicum spp.) is the primary host; nightshade is a less preferred secondary host.

Damage:

- Yield reduction from early abscission of attacked fruit.
- Infested fruit usually contain frass and decaying tissue.
- Adult weevils also transmit internal mold of peppers.
- Fruit infested near maturity may not fall, resulting in the potential for infestation and rejection of pepper shipments.

Phenology:

- Multiple generations per year; 21 day average life cycle (in mild temperatures); adult females can lay up to 340 eggs.
- In warmer areas (i.e. without killing winters) adults are present year round provided suitable host plants or plant materials are present. In other areas, weevils must "hitchhike" on transplants, within fruit, or migrate.
- Adults usually arrive on peppers when they are beginning to bud.

Lure:

Pherocon® dual lure attractants.

Lure Storage:
Store in unopened factory-sealed packages in a refrigerator or freeze.

Trap Design:
- ***Pherocon® PEW Monitoring Trap - Two-sided, yellow, sticky card. Position on suitable user-supplied poles, stakes, or laths.***

Placement Timing:
- Variable with location, usually two weeks before bud to detect first adult emergence or migration into field.
- Trap effectiveness will probably decrease with maturation of pepper plants and with changes in pepper weevil population dynamics, due to competition from native males and increased numbers of already mated females.
- Traps may capture a large proportion of the population at the end of the season when fields are cultivated or after a hard freeze.

Placement Pattern:
- Position traps on suitable poles, stakes or laths just above the canopy of the plant. The bottom of the trap should be at the top of the plant. Use wire ties or rubber bands to position traps in the vertical position on poles or stakes, or staple to a length of lath.
- Initially, use a perimeter pattern to intercept first generation adults as they move into the field. Place traps 3 to 4 rows into the field (approximately 15 feet or 5 meters) on the leeward side or the down-wind side. Also, you may need to position traps on the side or the field where night shade, tomatoes, or other potential alternate hosts may be located. Additionally, be sure to set up traps within the field for accurate monitoring. We recommend 1 trap per 2.5 acres or 1 hectare in addition to the leeward or alternate host sides of the field. Initially use a perimeter pattern to intercept first generation adults as they move into a field.
- As plants mature use a grid pattern to capture second and later generations as they emerge.

Trap Density:
- Minimum of 2.5 acres or 1 hectare, in addition to the leeward or alternate host sides of the field.
- In areas with a history or presence of heavy infestation pressure, use one trap per acre.

Trap Maintenance:
- Replace lure system every two weeks. Be sure to use both lure dispensers.
- Replace sticky card trap every two weeks, or sooner if heavy dirt or dust build-up on glue surfaces reduces catching efficiency.
- Remove unexpired lure dispensers from old trap and reposition on new trap. Be sure to remove release paper from both sides of trap to assure maximum catching efficiency.

Recommendations:

- Control measures generally are triggered when a single adult pepper weevil is captured.
- Use traps to identify the direction adult migration is coming from, and to isolate "hot spots," so control measures can be concentrated where they are most needed.
- Continue trapping program throughout growing season to monitor entire crop and check effectiveness of control measures being used.

Never

- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Description:

Adults:

Small mottled gray and brown. When wings are folded appearance is elongated and slender with fringe on wing tips. Active at night and hide in sheltered places during the day.

Eggs:

Eggs are very small, 0.2 by 0.1 in or 0.5 by 0.25 mm, laid singly or in small groups.

Larvae:

Length approximately 0.04 in or 1 mm, white when first hatched, with dark brown heads. Turn to pink in the third instar and reddish pink in the fourth instar. Mature larvae are about 0.4 - 0.5 or 10 - 12 mm long.

Pupae:

Formed in silk cocoon on the ground, in soil or inside damaged bolls.

Hosts:

Cotton, okra, occasionally on weeds and ornamentals in cotton family.

Distribution:

Present in most areas where cotton is grown.

Damage:

- Damage both squares and bolls; damage to bolls most serious.
- Larvae bore into bolls to feed on seeds damaging lint.
- Reduces yield if more than 20% of bolls are damaged.
- Damaged bolls are vulnerable to infection by fungi that cause boll rot and produce aflatoxin.
- Bolls most susceptible about 21 days after flowering (Pima variety are susceptible up to 30 days after flowering).

Phenology:

- Four to five generations per year.
- Passes the winter as long-cycle larvae in diapause.
- Can emerge as early as February, but peak emergence is usually from April to June.
- Overwintered larvae pupate in spring and adults emerge beginning a series of summer generations.
- First one or two generations feed on squares, later generations feed on bolls.

Degree-Day (D°) Models for Predicting Emergence Developmental Threshold/Each Model:

	Lower Limit	*Upper Limit*
Model A	60° F or 15.5° C	N/A
Model B	55° F or 12.7° C	86° F or 30° C
Model C	55° F or 12.7° C	N/A

Degree-Day from Jan 1 for Emergence/Each Model:

	Spring Generation		
	Begin	*Peak*	*End*
Model A	200 D° F or 111 D° C	675 D° F or 375 D° C	1100 D° F or 610 D° C
Model B	500 D° F or 735 D° C	1180 D° F or 655 D° C	2200 D° F or 1221 D° C
Model C	500 D° F or 277.5 D° C	875 D° F or 486 D° C	2250 D° F or 1249 D° C
	Summer Generation		
Model A	.....//.....	967 D° F or 537 D° C	
Model B	.....//.....	800 D° F or 444 D° C	
Model C	.....//.....	750 D° F or 416 D° C	

Lure:

• Pherocon® controlled release septa.

Lure Storage:

• Store in unopened factory-sealed packages in a cool place (75° F or 23.9° C maximum).

• Refrigerate or freeze carryover for annual storage.

Trap Design:

• Pherocon® 1C.

Placement Time:

• Place in field at first square.

Placement Pattern:

• Place traps at least 50 rows from edge and 50 paces from end of field.

• Attach traps to stakes so they can be raised as plants grow to keep traps at top of canopy.

Trap Density:

• At least two per field.

• One per 20 acres or 8 hectares.

Trap Maintenance:

- Check traps every 1 - 3 days.
- Replace traps after catching a total of 100 moths or when traps get dirty.
- Keep traps horizontal and parallel to wind.
- Change lure monthly.

Recommendations:

- Limit insecticide treatments to when susceptible bolls are present.
- Pheromone traps and degree-days help concentrate sampling to when PBW adult catches are increasing and susceptible bolls are present.
- If flight is low boll, sampling is not necessary.
- If flight is underway, sample bolls to determine if treatment is needed.

  However, traps can also be useful for treatment decisions if boll sampling shows population is near a treatment level. (Example: if trap catches and degree-days indicate the population peak has passed, then treatment may be delayed until next generation. Conversely, if the peak is yet to come, then treat immediately.)
- Compare trap catches to previous trap catches at comparable degree-days. This will allow you to estimate expected population pressure.

Boll sampling:

- Boll sampling is the only reliable way to determine infestation level.
- Pick 25 bolls at random in each quarter of the field or each 8 hectares (20 acres), if over 80 acres or 32 hectares.
- Pick bolls as you walk, one or two from each chosen plant.
- Choose bolls at random and not at field edge. Do not limit samples to where growth is rank.
- Choose bolls 14 to 21 days old.
- Crack bolls open and check for larvae. (This does not have to be done in the field.)
- It is important to detect small larvae so insecticides can control adults.
- Count bolls as infested only if larva is found.

Treatment Thresholds

- Southern California & Arizona. . . . . 10% infested susceptible bolls
- New Mexico. . . . . 5% to 10% infested susceptible bolls

Never

- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Description:

Adults:

Small gray moth with gray-brown or black marking, wing span of 0.5 in or 12 mm. Wings are held close to the body when at rest causing it to appear long and narrow.

Eggs:

Oval, range from white to yellow, very small. Laid on foliage, soil, plant debris or exposed tubers.

Larvae:

Vary in color from whitish, dirty white to grayish, pink. Greenish when feeding in stems or leaves. Mature larvae are 0.4 in or 10 mm in length with a brown head and dark prothoracic shield.

Pupae:

Smooth, brown in a silk cocoon, which is covered with soil particles or bits of plant debris.

Hosts:

Potato, tomato, eggplant, black nightshade, silverleaf nightshade and jimsonweed.

Distribution:

Worldwide pest of stored potatoes. Attacks potatoes before harvest in warmer areas from Stockton and Salinas southward. It has also been found in Arizona, New Mexico, and southwestern Utah.

Damage:

- Larvae reach potato tubers through cracks in the soil. On young tubers larvae feed just below skin, but eventually tunnel deep in the flesh.
- Infested tubers are unmarketable. There is some feeding on leaves, petioles or stems, however this rarely causes damage to the plant.

Phenology:

- Development takes place year round. Most infestations originate from infested potato plants and tubers left in fields and cull potato piles. Completes a generation in 3 to 4 weeks in summer. About half the time is spent in the larval stage. In winter larvae may require 3 months or more to complete development.

Life Stages/degree-days:

Life Stage	*Average D° F*	*Average D° C*
Eggs:	97.7	54.2
Larvae:	283.1	157.1
Prepupae:	58	32.1
Pupae:	141.5	78.5
Generation Time:	580.3	322
Pre-Egglaying Adults:	549	30.5

(Threshold temps: Lower 54.7° F or 10° C.)

Lure:
• Pherocon® controlled release septa.

Lure Storage:
• Store in unopened factory-sealed packages in a cool place (75° F or 23.9° C minimum).
• Refrigerate or freeze carryover for annual storage.

Trap Design:
• Pherocon® 1C.

Placement Time:
• When tubers begin to form or at least 60 days prior to harvest.

Placement Pattern:
• One trap in each corner of the field, but at least 14 rows or 50 feet or 15.25 meters within the field. On the top of the bed.

Trap Density:

Number of traps	*Acreage*	*Hectacres*
Minimum of 4 per field	----	----
One trap per 10 acres or 4 ha.	> 40	> 16

Trap Maintenance:
• Check at least once per week, best if done twice weekly.
• Replace lures monthly.
• Replace liners monthly or when dirty.

Recommendations:
Treatment levels are not established for all areas. Use following levels of moths per trap per night as guidelines:
• Bakersfield, California: Treat when population levels reach 15 to 20 moths, per trap, per night or when the average for the season reaches 10 moths, per trap, per night for table varieties such as White Rose and Centennial.
• Salinas, California: Maximum population levels of 40 moths, per trap, per night, with a seasonal mean of 15 to 20 M/T/N for chipping varieties such as Kennebec.

Never
• Use more than one lure per trap
• Fail to count as recommended
• Fail to record trap counts
• Fail to change liners when needed
• Fail to change lure as recommended
• Discard lures within field
• Fail to follow recommendations

Description:

Adults:

Adult moths are active at night. They lay single eggs on most parts of the plant but prefer young shoots and the peduncles and bracts of blower buds and bolls. Adult moths have a wing span of 0.75 - 0.9 in or 20 - 22 mm. The abdomen and hindwing are a uniform silvery or creamy-white, but color may vary from silvery-green to straw-yellow. There are three more or less distinguishable transverse lines of darker shade across the forewings. The female moth is capable of laying up to 400 eggs under optimum circumstances, however temperature and larval hosts can have a profound effect on the number laid.

Eggs:

Spherical, 0.3125 in or 0.5 mm in diameter. light blue-green when laid. Eggs have approximately 30 longitudinal ridges which form a crown causing the egg to resemble in miniature, the fruit of a poppy of pomegranate.

Larvae:

Full grown larvae are about 0.625 - 0.75 in or 15 - 18 mm long, light brown in color, tinged with gray or green. They have a distinctly paler dorsal line. Larvae have dark brown or black spots at the base of setae on each segment. In addition the last two thoracic and all the abdominal segments have two pairs of tubercles, one dorsal and the other lateral. These are always more pronounced on the last two thoracic segments. In addition there are yellow spots at the base of the tubercles, especially noticeable at the base of the thoracic segments. There are five larval instars.

Pupae:

Pupae are about 0.625 in or 13 mm long, chocolate brown, with the head and tip of the abdomen bluntly rounded. Pupae are enclosed in a dirty white or pale brown cocoon which is usually attached to the plant or plant parts. Only occasionally found in cracks in the soil.

Distribution:

Distributed over most of Africa, including Madagascar, Mauritius and the Canary Island. It extends northward to southern Europe, and eastward through the Near and Middle East, including southern Arabia, to India and Southeast Asia. Specimens have also supposedly been collected from Japan, Formosa and the Philippines and are probably present in Australia.

Damage:

- Bores into the tips of shoots early in the season causing cotton to become bushy and delay maturation.
- Later larvae tunnel in flowers squares and bolls, which cause them to shed, therefore reducing the crop.
- Green bolls are also attacked which may either cause them to drop or be partially damaged and lowers fiber quality. Larvae move about and may attack several bolls or terminals during their lifetime.

Phenology:

- The theoretical lower threshold for development is about 53.6° F or 12° C. Although constant temperatures at 53.6 ° F or 12° C will cause death, it will survive short periods at this temperature.
- At 60.8° F or 16° C a generation can be completed in 88 days, while at 95° F or 35° C it can be as short as 23 days.
- A constant temperature of 104° F or 40° C is fatal to all stages, although eggs can withstand this temperature for 12 hours.
- The lower and upper developmental thresholds are likely approximately 53.6° F or 12° C and 95° F or 35° C, respectively.

LIFE STAGE LENGTH, SUMMER

Incubation period of egg ..... about 3 days

Duration of larval stage..... about 2 weeks

Duration of pupal stage..... about 2 weeks

Pre-oviposition period..... about 3 days

Total generation time..... about 5 weeks

Lure:

- Pherocon® Septa Controlled Release Dispenser.

Lure Storage:

- Sensitive chemistry — store at 60° F or 20° C or lower at all times; best to refrigerate at 41° F or 5° C; or store at 50° F or 10° C for multiseasonal use.

Trap Design:

- Pherocon® III D.

Placement Time:

- One to two weeks prior to earliest known emergence.

Placement Pattern:

- At field edge; five rows inside and at least one trap in center. Maintain 82 feet or 25 meter intervals.

Trap Density:

- At least two per field.
- One per 20 acres or 8 hectares.

Trap Maintenance:

- Change lures at 4-week intervals.
- Change sticky traps after 6 weeks or when glue loses tack.
- Service other traps as shown in instructions

Treatment Recommendations:

- Initiate sprays based on moths/trap/night per local extension recommendations.

Or

- Initiate sprays for heavy infestations following increase in adult capture.

Alternative Recommendations:

- Where spiny bollworm is a problem, the same control program for pink bollworm such as short season cotton, early plowdown, and destruction of alternate hosts are recommended.
- Minimal treatment of other pests to preserve beneficial insects is also recommended.
- It is difficult to control with conventional insecticides.

Never

- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Description:

Adults:

The adult moth is about 0.5 in or 13 mm long, and has a black body with two to three yellow marks on the thorax. It strongly resembles a yellow jacket. The hind wings are transparent and the forewings have two transparent patches.

Eggs:

The eggs are brown, oval-shaped, and approximately 0.02 in or 0.5 mm long. They are sculptured on the surface and distinctly cupped on the sides.

Larvae:

The larvae are only 0.0625 in or 1.5 mm long when first hatched. They grow to a length of approximately 0.80 in or 20 mm at maturity, and feature a white body and a dark brown head. The abdomen may take on a pinkish or brown color from the food inside. Larvae have three pairs of wiry brownish legs on the thorax and five pairs of prolegs on the abdomen.

Host:

Strawberries, raspberries, and loganberries.

Damage:

- Larvae destroy the crown and root tissue of strawberry plants by feeding in these areas.
- Feeding process wounds the plants and allows the entry of root disease.
- Injured plants look stunted, produce poor food yield and readily separate from the root at the crown line when pulled.

Phenology:

- One generation per year.
- Overwinters as nearly mature, diapausing larva in the crown of the strawberry.
- Larva pupates during May and June within a frass-covered silk cocoon.
- Pupal stage lasts about 3 weeks.
- Moth emerges from late May through July.
- Females begin to attract males on the day of emergence and egg deposition commences within 1 to 2 days.
- Peak flight occurs usually within 4 to 5 days of July 1.
- Most eggs hatch between late June and mid-August.

Trap Design:

- Pherocon® 1C trap.

Lure:

- Pherocon® controlled release septa.

Placement:

- Place 1 to 2 traps near the upwind margin of field.
- Place the remainder in a grid pattern or at select locations throughout the field.

Placement Time:
- One to two weeks before emergence.
- Mid-May.

Trap Density:
- Minimum of 3 traps.
- One trap every 5 acres or 2 hectares in larger plantings.

Trap Maintenance:
- Check 2 to 3 times per week.
- Replace lures every 4 weeks.
- Replace liners every 6 weeks or when dirty.

Recommendations:
- Use trap counts for detection of adult emergence.
- If temperatures remain warm, spray about 9 days from first consistent adult trap catch (3 to 4 weeks).
- If experiencing cool/rainy days, spray about 12 days after emergence.
- If trap catches are high during peak emergence (approximately July 1 - 6) retreat.

Alternative Recommendations:
- Remove infested plants and replant or allow runners to fill area.
- Following harvest, leave a few untopped plants to attract ovipositioning females. Disk these rows under in September.
- Wait until September to disk under infested fields. This will help restrict infestation to infested fields.
- Avoid planting new strawberry fields adjacent to infested ones.
- Plant a fall or spring grain crop between infested fields and new fields.

Never
- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

Description:

Adults:

Light gray peppered moths with small, black flecks.

Eggs:

Small size, seldom noticed, laid on underside of leaves.

Larvae:

Early instars: Light colored and smooth.

Late instars: Gray or yellowish, irregular band of red-purple across each segment.

Pupae:

Slender, brown, enclosed in loose silk cocoon in soil or debris.

Hosts:

Tomato, eggplant, nightshade, and other solanaceous plants.

Damage:

- Leaf miners: First instars tend to mine leaves creating a narrow mine. Later instars enlarge mine into irregular blotch and fold section of leaf over mine creating shelter with silk to fasten edges. Larvae can complete development in leaf shelter.
- Fruit Damage: Young larvae usually bore into fruit under the calyx and then tunnel to its core. Several larvae may infest the same fruit at any state of ripeness.
- Reduced harvest quality: Create narrow blackened tunnels exposing fruit to decay. Difficult to sort out infested fruit leading to possible contamination.

Phenology:

- Seven to eight overlapping generations per year.
- Life cycle is less than 30 days in summer, 3 - 4 months in winter.
- Warm Weather Cycle:

Eggs . . . . . .5 Days
Larvae . . . . . .10 Days
Pupae. . . . . .11 Days
Adult . . . . . .10 - 14 Days
Pre-Oviposition . . . . . .2 Days

No diapause until host plants are absent.

Population Dynamics:

- Population pressure is dependent on temperature and availability of host plants.
  Mild winters = heavy spring infestation.
  Host-free period = reduced infestation.
- Infestations begin at edge of field from any side and move any direction.
- Infestations can originate from infested greenhouse transplants.

Lure:
• Pherocon® TPW controlled release septa.

Lure Storage:
• Store in unopened factory-sealed packages in a cool place (75° F or 23.9° C maximum).
• Refrigerate or freeze carryover for annual storage.

Trap Design:
• Pherocon® 1C.

Placement Time:
• Distribute traps at planting time.

Placement Pattern:
• Distribute traps in grid pattern.
• 30 feet or 10 meters inside the field.
• Place trap level with top of plant.
• Move trap higher as plant grows.

Trap Density:

Number of traps	*Acreage*	*Hectacres*
Minimum of 2	1 - 10	0.5 - 4
One trap per 10 acres or 4 ha.	> 10	> 4

Counting Traps:
• Check traps minimally 2 times per week.
• Count and record the number of moths captured.
• Remove adults and stir glue when feasible.

Trap Maintenance:
• Replace trap liner once or twice each per month minimum.
• Replace trap liner when sticky surface is dirty.
• Replace lure every two weeks.

Trap Interpretation/ Recommendations:
• Initiate monitoring when field is planted.
• TPW is difficult to control due to overlapping generations and short life cycle that leads to rapid population increase.
• It is critical to keep populations below damaging levels as long as possible.
• For conventional treatments: Apply treatments when average of 20 moths per trap per night is captured over a 10-day period.
• For mating disruption treatments: Apply/reapply treatments when average of 3 moths per trap, per night is captured over a 10-day period. Continue monitoring throughout season.

Supplementary Monitoring/Control Techniques

- Carefully check for mines and folded leaf shelters on all foliage in 10 feet or 3 meters long sections of row.
- Apply control measures when population reaches 5 - 10 larvae per 10 feet or 3 meter row section.
- Larval density on leaves is an indicator of fruit infestation levels in 14 days.
- Continue sampling at least weekly.

Other IPM Recommendations:

- Implement host-free period between crops; destroy crop residue immediately and eliminate abandoned fields.
- Maintain pest-free transplants.

Source: Recommendations and certain other sections were sourced from University of California "Integrated Pest Management for Tomatoes."

Never

- Use more than one lure per trap
- Fail to count as recommended
- Fail to record trap counts
- Fail to change liners when needed
- Fail to change lure as recommended
- Discard lures within field
- Fail to follow recommendations

STORAGE RECOMMENDATIONS

Shelf life was one of the more difficult problems to overcome when pheromone based monitoring systems were introduced more than 20 years ago. Pheromones, being rather volatile, tend to be released through most commonplace packaging materials. In addition, some pheromone components react with atmospheric oxygen, changing the attractive chemical to an inactive component. It was therefore necessary to develop a packaging system capable of maintaining a controlled environment around the pheromone lures.

Trécé has eliminated most of these problems by packaging its lures in a relatively impermeable foil packet, under an inert atmosphere. However, this does not keep the pheromone lures from "aging" somewhat over time. This aging may decrease the efficacy of some of our pheromone lures. It has, therefore, become necessary

to provide our valued customers more complete storage recommendations for maintaining the highest possible attraction of our lures.

In determining the criteria for these storage recommendations, it was taken into account that different pheromones can be drastically different in chemical structures and properties. All of the lures that Trécé sells are viable after one year of storage at virtually any normal temperatures. It is only after this first year that the changes due to pheromone structures become obvious. Therefore, we have determined the most efficient storage methods/timing for individual pheromone lures (see our catalog for definition of lures codes).

NOTE: Certain lures that are kept longer than recommended may still be used, but should be replaced more often than normal due to their increased age. However, when in doubt, replace.

The recommended time (in years) of storage is related to the storage method in the table entitled STORAGE RECOMMENDATIONS. The following legend should be used:

Room temperature (75° F or 23.9° C maximum) . . . . . ▲
Refrigerated (32° F - 45° F or 0° C - 7.2° C) . . . . . ●
Frozen (32° F/0° C or below) . . . . . ■

Trécé personnel are always available to answer any particular questions you may have regarding these storage recommendations.

Room temperature (75° F or 23.9° C maximum) ▲
Refrigerated (32° F - 45° F or 0° C - 7.2° C) ●
Frozen (32° F/0° C or below) ■

CAP CODE	1 YEAR	2 YEARS	3 YEARS
ABM	▲ ● ■		
ARB	▲	●	■
ADOX-O	▲	●	■
ACM	▲	●	■
AEM	▲	● ■	
AFL	▲	● ■	
AGM	▲	●	■
ALM	▲	●	■
AMOR-SC	▲ ● ■		
AMOR-SC	▲ ● ■		
AMW	▲ ● ■		
APB	▲ ● ■		
AROS	▲	● ■	
ARPO	▲	●	■
ASB	▲ ● ■		
BAW	▲	● ■	
BCW	▲	● ■	
BGW	▲ ● ■		
BFM	▲	● ■	
BRA	▲	●	■
BW	▲ ● ■		
BWW	▲ ● ■		
CA	▲	● ■	
CACO	▲	●	■
CB	▲	● ■	
CBG	▲ ● ■		
CBT-1	▲	● ■	
CCW	▲	● ■	

Room temperature (75° F or 23.9° C maximum) .....▲
Refrigerated (32° F - 45° F or 0° C - 7.2° C) .....●
Frozen (32° F/0° C or below) .....■

CAP CODE	1 YEAR	2 YEARS	3 YEARS
CEW	▲ ● ■		
CFB/RFB	▲ ● ■		
CFM	▲ ● ■		
CL	▲	● ■	
CM	●	● ■	■
CM 10X	●	● ■	■
CM-L2	●	● ■	■
CRS	▲	●	■
CRS 10X	▲	●	■
DBM	▲	● ■	
DSB	▲	● ■	
DWB	▲	●	■
ECB-I	▲	●	■
ECB-II	▲	●	■
ECB-III	▲	●	■
EGVM	▲	● ■	
EPSM	▲	● ■	
ESB	▲ ● ■		
FAW	▲	● ■	
FBW	▲	● ■	
FCM	▲	● ■	
FTLR	▲	●	■
GBM	▲	● ■	
GFUN	▲	● ■	
GM	▲	●	■
GPTB	▲	●	■
HSW	▲	● ■	
IMM+4	▲	●	■

Room temperature (75° F or 23.9° C maximum) ▲
Refrigerated (32° F - 45° F or 0° C - 7.2° C) ●
Frozen (32° F/0° C or below) ■

CAP CODE	1 YEAR	2 YEARS	3 YEARS
JB	▲	●	■
KB/WB	▲ ● ■		
LAW	▲	● ■	
LBAM	▲	● ■	
LCSB	▲	● ■	
LEM	▲ ● ■		
LGB	▲ ● ■		
LILA	▲	●	■
LPTB	▲	●	■
MFF	▲ ● ■		
MRB	▲	● ■	
MSB	▲	●	■
NPTM	▲	● ■	
OBLR	▲	● ■	
OFM	▲	● ■	
OLF	▲	● ■	
OLP	▲	●	■
OLR	▲	● ■	
OM	▲ ● ■		
OT	▲ ● ■		
PBW	▲	●	■
PH	▲	● ■	
PL	▲	●	■
PTB	▲ ● ■		
PTM	▲	● ■	
PWC	▲	● ■	
RBLR	▲	● ■	
SBW	▲ ● ■		

Room temperature (75° F or 23.9° C maximum) ▲
Refrigerated (32° F - 45° F or 0° C - 7.2° C) ●
Frozen (32° F/0° C or below) ■

CAP CODE	1 YEAR	2 YEARS	3 YEARS
SBCB	▲	● ■	
SBW	▲ ● ■		
SCB	▲ ● ■		
SCM	▲	●	■
SHM	▲	● ■	
SJS	▲	● ■	
SPAR	▲	● ■	
SPM	▲	●	■
SPOD I	▲	● ■	
SPOD II	▲	● ■	
SPOD III	▲	● ■	
SWCB	▲ ● ■		
SYM	▲ ● ■		
TBM	▲	● ■	
TBW	▲ ● ■		
TLM	▲	● ■	
TPW	▲	● ■	
UGG	▲	● ■	
VGC	▲	● ■	
VLR	▲ ● ■		
WBCW	▲	● ■	
WMT	▲	●	■

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