New Insecticides, Application Timings, and Registration Updates

Western cherry fruit fly

Peach twig borer

Codling moth

Diane Alston
Utah State University Extension

Northern Utah Fruit Growers Meeting
February 6, 2007

Update on Guthion Registration

- Apple, Pear, Sweet & Tart Cherry
  - Registration will end in 2012
  - Phase-down of allowed pounds per acre for the season
  - 60 ft buffer from treated orchards to bodies of water
  - 60 ft buffer from orchards to human occupied buildings
  - Lengthy PHI for U-pick orchards

Western Cherry Fruit Fly

Utah State University Extension

Utah Pests Fact Sheet

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Western Cherry Fruit Fly (*Rhagoletis indifferens*)

Diane Alston, Extension Entomology Specialist • Marion Murray, IPM Project Leader • Michael Reding • Carin Miller

Do You Know?

- Western cherry fruit fly is the primary insect pest of sweet and tart cherries in Utah
- Damage occurs from the larva developing inside fruit
- Females lay eggs under the skin of fruit, so target adult flies for control
- Insecticides are currently the most effective control method
- A new insecticide technology–attract-and-kill (bait plus insecticide)–can be effective for control in commercial and home cherry trees
- Use of ground barriers (mulch, fabrics) can reduce pupation and fly emergence
- Post-harvest sanitation can reduce populations

Figure 1. Adult fly caught on trap.[1]

Figure 2. Larvae feeding inside a cherry fruit.[2]

Figure 3. Damaged cherries with larval exit holes.[3]

Figure 4. Cherry fruits are not susceptible to attack until they have a blush of salmon color.[4]

The western cherry fruit fly (Rhagoletis indifferens) is the most important pest of tart and sweet cherries in Utah. Once the skin of fruits becomes soft enough to penetrate, adult females (Fig. 1) insert eggs with their ovipositor, and larvae develop inside the fruits (Fig. 2). The result is "wormy" fruit that is unmarketable. It is difficult to determine whether a fruit is infested until the larva exits through a hole that it chews (Fig. 3) or the fruit is cut open to reveal the larva inside. For processed cherries, detection of one larva by the processor can result in rejection of the entire crop from that orchard and/or farm. Therefore, the best management strategy is to prevent fruit infestation.

Adult flies will migrate only short distances (< 40 m) if host fruit is available. This causes infestations to be spotty in a region; however, once established in an orchard, the western cherry fruit fly can spread rapidly and require annual control. Protective insecticide sprays are currently the major tactic for preventing infestation. A new insecticide technology called "attract-and-kill," where adults are enticed to feed on a sticky bait droplet containing an ultra low concentration of insecticide, has proven effective in experiments in Utah orchards.

There is one generation per year; however, adults can emerge from the soil over a period of 12 weeks or more. Cherry fruits are susceptible to infestation from when they first ripen to a salmon-blush color (Fig. 4) until they become too soft or fall from the tree.

HOSTS

Sweet, tart, and wild species of cherries

LIFE HISTORY

Pupa – Overwintering Stage

- Size: about 5/16 inch (5 mm) long
- Color: light to dark brown and shaped like a large grain of wheat
- Where: overwinters in the soil of the orchard floor, 1 - 4 inches (2.5 - 10 cm) deep
- Rate of pupal development and adult emergence affected by soil temperature and moisture

Adult – Monitoring Stage

- Size: about 1/4 inch (5 mm) long
- Color: black body with white bands on abdomen (posterior body region); wings are transparent with a distinctive pattern of dark bands (Figs. 1 and 6)
- When: adults begin emerging from soil in late May to early June (Table 1 and Fig. 5) depending on soil temperature and moisture and continue to emerge throughout the summer and into early fall
- After emerging, females require about 5 - 7 days (190 degree-days) to become sexually mature, after which they can begin laying eggs
- Females lay eggs under the skin of fruit without leaving visible marks, over a period of about 30 days

Egg

- Size: about 1/32 inch (0.8 mm) long
- Color and shape: yellowish and elongated with a stalk at one end
- Where: deposited beneath the skin of cherry fruits
- Eggs hatch in 5 - 8 days

Larva – Damaging Stage

- Size: mature larvae are about 5/16 inch (8 mm) long
- Color and shape: creamy white, legless maggot; tapered at the head and rounded at the tail (Fig. 2)
- Where: lives and feeds in the fruit
- After approximately 14 - 21 days, full-grown larvae exit from the fruit, drop to the ground, burrow into the soil, and pupate

Figure 5. Life history of western cherry fruit fly. There is one generation per year.

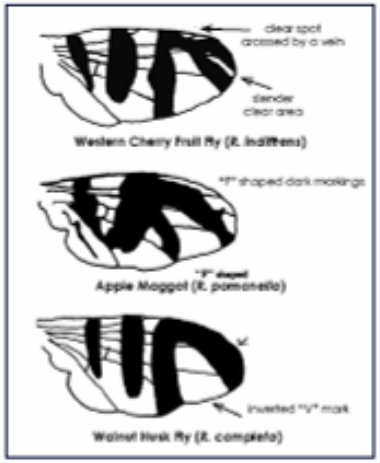
HOST INJURY

Larvae feed within the fruit on the flesh, rendering the fruit unmarketable (Fig. 2). There is no noticeable evidence on the outside of a fruit indicating infestation until after larvae emerge through exit holes (Fig. 3). Large populations can infest a high percentage of the fruit on a tree. Peak emergence of adults and infestation of fruit occurs from mid-June to mid-July.

TIMING CONTROL

Insecticide treatments should be timed to prevent adult mating and/or female fruit flies from laying eggs in developing fruit. There are three methods to determine proper timing of sprays. Method 1 should be used in combination with Methods 2 or 3.

Figure 6. Illustration of fruit fly wing banding patterns.



Method 1: Fruit Maturity

Cherry fruits are not susceptible to egg-laying by adult females until they ripen to a salmon blush in color (Fig. 4). Green fruits will not be attacked. Consider the maturity of the ripest fruit in an orchard, not the average.

Method 2: Adult Trapping

Adult flies do not use sexual pheromones, but are attracted to certain colors and odors. Yellow sticky panel traps (Pherocon AM8) with an external bait of ammonium carbonate (AC) are a moderately effective monitoring tool (Fig. 7); unbaited traps should not be used. Place traps in cherry orchards before the first fly is expected (750-800 degree-days [DD], or by mid-May (Tables 1 and 2). Apply the first insecticide treatment 5 - 7 days (190 DD) after first catch (females require 5 - 7 days for ovaries to mature after emergence).

Trap Placement and Servicing

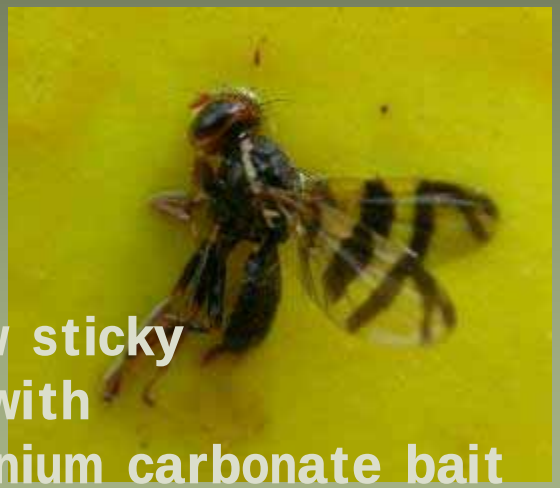
- Place AC-baited Pherocon AM8 traps on the southern side of trees (flies emerge first and are more active on the warmer side of trees).
- Place traps at least 6 ft high, preferably in the upper 1/3 of the tree canopy.
- Remove fruit, leaves, and twigs within 6 inches of the trap.
- A minimum of two traps should be placed in each orchard. Research conducted in Utah commercial cherry orchards ≥ 10 acres in size has shown that 1 - 2 traps per acre catches significantly more flies than

!New Fact Sheet!

Key Points of Interest in Cherry Fruit Fly Life History

- Adults fly only short distances (<40 m)
- Females lay eggs under skin of fruit, so target adult flies for control
- Adult flies are the monitoring stage
- Fruits too hard for egg laying until they begin to color

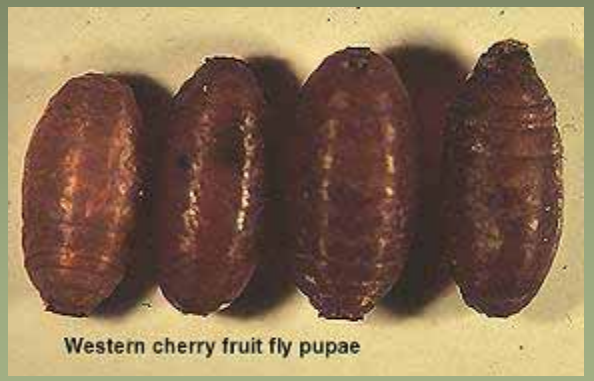
Yellow sticky trap with ammonium carbonate bait



Key Points of Interest in Cherry Fruit Fly Life History

- One generation per year, but adults emerge over 12 weeks or more (late May to September)
- Full-grown larvae exit fruit and burrow into soil to pupate
- Spend winter as pupae in the soil

Exit hole



Western cherry fruit fly pupae

Timing Control of Cherry Fruit Fly

- Insecticides are the most effective control method
- 3 methods to time sprays
  1. Fruit Maturity (use in combo with another method)
  2. Adult Trapping
  3. Degree-Day Model

#1: Fruit Maturity

- Cherry fruits are not susceptible to egg-laying by adult females until they ripen to a salmon blush in color
- Green fruits will not be attacked
- Consider the maturity of the ripest fruit in the orchard, not the average

#2: Adult Trapping

- Adult flies are attracted to certain colors and odors
- Yellow sticky panel (Pherocon AM®) + ammonium carbonate bait
- Place traps before first fly is expected
  - 750-800 DD
  - by mid-May
  - on southern side of trees, > 6 ft high, upper 1/3 of canopy, remove obstructions
  - minimum of 2 traps per orchard, preferably 1-2 traps per acre, place on borders & interiors & “hotspots”
  - replace when covered with debris/insects, refill AC bait boxes
  - keep a trap catch record
  - inspect banding pattern to determine fruit fly species
- Spray within 5-7 days after first fly is caught

#3: Degree-Day Model

Major events in western cherry fruit fly management. Timing of events is based on degree-day accumulations* and first activity of adults.	
Degree-Days (DD)	**Management Event**
750-800	Place traps in orchards
900-950	First adult flies expected on traps; treat 5-7 days or 190 DD after first fly is caught if cherries have developed blush color
1060	3% of flies emerged, 1% of flies sexually mature
*Based on 41°F lower threshold and no upper threshold for development. Begin accumulating DD Jan. 1.	

#3: Degree-Day Method

- Use 1060 DD as a guideline to initiate sprays if you don't have fly trapping information
  - 3% fly emergence & 1% females with mature ovaries
- Need max/min temperature data & look-up table (see WCFF fact sheet)
- Or go to the USU Extension IPM Web Page for "Pest Advisory" information
  - http://utahpests.usu.edu/ipm/htm/advisories

Commercial Orchard Insecticides

- Organophosphates
  - Guthion – 14 d
  - Imidan – 14 d
    - do not use on sweets
  - Lorsban – 14 d
    - do not use on sweets
  - Diazinon – 10-14 d
- Synthetic pyrethroids 7-14 d
  - Ambush, Pounce
  - Asana
  - Baythroid
  - Warrior

- Neonicotinoids
  - Provado – 14 d
- Spinosad – 7 d
  - GF-120 (bait spray)
  - Success
  - Entrust – organic
- Sevin – 5-7 d
- Malathion – 3-5 d

-Reapply based on protection interval of insecticides
-Rotate type of insecticides between applications to reduce likelihood of resistance & negative effects on beneficials

Attract-and-Kill

- GF-120
  - mixture of bait + ultra-low concentration insecticide (0.2% a.i. spinosad)
  - applied with a 4-wheeler, electric-pump sprayer
  - not rainfast
  - must maintain enough droplets to “feed” your fruit fly populations

Cultural Controls

- Ground covers and mulches
  - dense ground covers/vegetation
  - landscape fabric
- Sanitation
  - keep cff populations low
  - destroy dropped fruit
  - remove “unmanaged” trees
- Biological control
  - Parasitic wasps, birds (fowl) rodents

Peach Twig Borer

Utah State University Extension

IPM 9/02

Peach Twig Borer

Anarsia lineatella

by Michael E. Reding and Diane G. Alston

Mature larva in shoot.

Do You Know?

- Major pest of peach, nectarine and apricot in Utah
- Overwintering larvae cause damage by tunneling in young shoots; control should be applied at delayed dormant timing
- Summer larvae directly attack fruit, typically, entering fruit near the stem end
- Use of pheromone traps and the degree-day model are critical for timing control targeting summer generations
- Insecticides are currently the major control tactic

The peach twig borer is one of the most significant pests on peach, nectarine, and apricot in Utah. There are three generations of peach twig borer in northern Utah and four in southern Utah. The larvae of the overwintering generation emerge during bloom to petal fall and burrow into developing shoots. When populations are high these larvae can cause substantial damage to young trees. The first adults are usually detected during mid- to late May in northern Utah. Most economic damage results during the summer when larvae of summer generations attack the fruit. Insecticides are currently the most effective control tactic. Pre-bloom to petal fall sprays that target the young larvae provide the best control of twig borer.

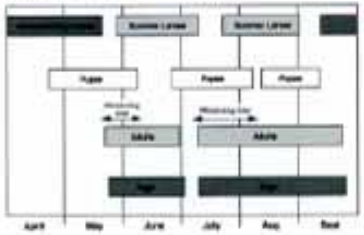
Hosts

peach, plum, apricot, almond, nectarine

In the spring, larva burrow into the developing shoots, which results in "flagging".

Larva of the summer generation turned in the fruit.

Life History



The arrows indicate when adults should be monitored with pheromone traps. To determine births, traps should be set out prior to moth flight (first arrow).

Larva—Overwintering Stage

- **Where:** overwinter as young larvae under the bark of the trunk or branches in silken cases called hibernacula.
- **When:** caterpillars emerge in the spring (bloom to petal fall) and chew their way into developing buds and terminals, hollowing out the shoot for a short distance and then moving to another one.
- **Size & color:** full grown larvae are about ½ inch long and chocolate brown in color with dark heads. The area between body segments is lighter in color giving the larvae a striped appearance.
- Mature larvae emerge from twigs and search for protected sites on the trunk and branches to pupate.

Pupa

- **Where:** usually found under barkscales or cracks in the bark.
- **Color:** smooth, brown and does not reside in a cocoon.

Adult—Monitoring Stage

- **When:** adults of the overwintering generation emerge during about a two-week period often beginning in mid- to late May in northern Utah.
- **Size:** about 1/3-1/2 inch long.
- **Color:** small gray moths with white and dark speckled wings.
- the female lays about 80-90 eggs.

Egg

- **Where:** eggs are deposited on shoots, the underside of leaves and developing fruit beginning about the time of shuck fall.
- **Color:** yellowish white to orange and oval-shaped

Larva—Damaging Stage

- **Where:** feed in the terminal shoots early in the season, but the summer generations attack the fruit about the time pits begin to harden.
- larvae generally enter fruit at the stem end, where two fruit touch or where leaves touch the fruit.
- These larvae complete development in the fruit, then emerge, pupate and become the second generation of adults.

Host Injury

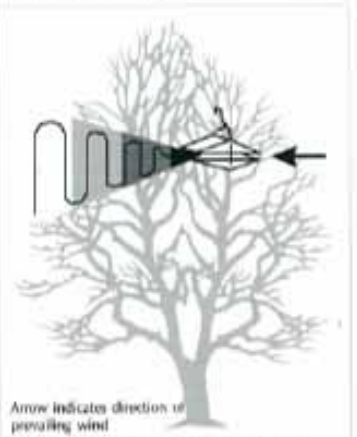
Shoots

- Larval feeding in terminal shoots causes leaves to wilt (flagging) and stops terminal growth.
- Terminal damage may occur especially on young trees with a high degree of late season vegetative growth.

Fruit

- Larval feeding in fruit renders it unfit for sale and may introduce microorganisms that cause rotting.

Timing Control



Arrow indicates direction of prevailing wind

- Place traps within the upper third of the tree canopy making sure the trap entrance is not blocked and that it is parallel to the prevailing wind direction.
- Dark line indicates moth flight trail up the pheromone plume to the trap

Figure 1. Proper placement of pheromone trap.

Key Points of Interest in Peach Twig Borer Life History

- Larvae spend the winter as young larvae in silken cases on limbs
- In the spring, larvae burrow into tender shoots/twigs
- Delayed dormant and bloom-time sprays can provide control

Key Points of Interest in Peach Twig Borer Life History

- Summer generation larvae attack fruit once terminal shoot growth slows down
- 3 summer generations in recent years
- Use pheromone traps to determine “biofix” (beginning of moth flight)

Early Season Control of PTB

- Delayed Dormant
  - Horticultural Oil
  - Synthetic Pyrethroids
    - Asana, Ambush/Pounce, Warrior
  - Lorsban, Diazinon, Thionex, Supracide
  - Success, Intrepid

- Pink to Petal Fall
  - Microbials
    - Bt (Dipel, Crymax)
    - Success
  - Insect growth reg.
    - Dimilin
    - Intrepid
  - Syn. Pyrethroids
  - Imidan, Thionex

- Prevent twig/shoot tunneling injury
- Lower the PTB population
- Many low toxicity options
- Minimize effect on beneficials

Timing Control of Summer PTB

- Delta or wing trap
- PTB pheromone lure
- Place traps by 300 DD after March 1, first moths expected by 400-450 DD, determine “biofix”

PTB Degree-Day Model

Major events in peach twig borer management. Timing of events is based on degree-day accumulations* and first activity of adults.	
Degree-Days (DD)	**Management Event**
300	Place traps in orchards
400-450 Reset DD to 0 at biofix	First moths expected, check traps every 1-2 days until biofix is determined
220 DD after biofix 300 DD after biofix	1% egg hatch 5% egg hatch
*Based on 50°F lower threshold and 88°F upper threshold for development. Begin accumulating DD Mar. 1.	

Commercial Orchard Insecticides

- Organophosphates
  - Imidan
  - Diazinon
  - Malathion
- Organochlorines
  - Thionex
- Carbamates
  - Sevin

- Synthetic Pyrethroids
  - Asana, Proaxis, Warrior, Pounce, Ambush
- Microbials
  - Success, Bt
- IGRs
  - Intrepid

Mating disruption:
-not as effective as for codling moth, but can use to eliminate some sprays

Codling Moth

UtahState University EXTENSION

Utah Pests Fact Sheet

Published by Utah State University Extension and Utah Plant Pest Diagnostic Laboratory ENT-13-04 November 2004

Codling Moth (*Cydia pomonella*)

Diane Alston, Extension Entomology Specialist • Marion Murray, IPM Project Leader • Michael Reding, Former IPM Project Leader

Do You Know?

- Codling moth is the major pest of apple and pear in Utah.
- Damaging stage: larva tunnels into fruit
- Monitoring stage: adult moth
- Use of pheromone traps and the degree-day model (based on daily temperatures) are critical for determining optimal treatment timings.
- Insecticides and pheromone-based mating disruption are currently the main management tactics.
- Insecticides are targeted at newly hatched larvae and/or eggs.
- Mating disruption devices need to be applied immediately after biofix (first moth activity) to prevent or adequately delay moth mating.
- Biological control is minimally effective because larvae are protected inside fruit.
- Insect development and spray timing information are available on the USU Extension Integrated Pest Management (IPM) Pest Advisories Web page (http://utahpests.usu.edu/ipm/htm/advisories) or from your county USU Extension office.

Codling moth (*Cydia pomonella* – Family Tortricidae) is the most serious pest of apple and pear worldwide. In most commercial fruit producing regions and home yards in Utah, fruit must be protected to harvest a crop. Insecticides are a main control tactic. There are new insecticide compounds available, many of which are less toxic to humans and beneficial insects and mites than earlier insecticides. For commercial orchards with more than 10 acres of contiguous apple and pear plantings, pheromone-based mating disruption can greatly reduce codling moth populations to allow reduced insecticide use. Effective biological control has not been possible because fruit is attacked by newly hatched larvae, which are protected from natural enemies once inside the fruit. Sanitation methods can help reduce codling moth densities within an orchard but alone cannot provide satisfactory control.

In Utah, there are two to three generations of codling moth each year (Fig. 3). In northern Utah, there are typically two full generations and a partial third generation. In southern Utah, most or all of a third generation will occur. First generation moths begin to emerge about bloom time and peak in June in northern Utah. Second generation moths begin emerging in late June to early July and peak in late July to early August. Third generation moths are active from about mid August to mid September before declining day length induces the end of activity for the year.

Fig. 1. Codling moth adult[2]

Fig. 2. Codling moth larva[2]

HOSTS

apple, apricot, cherry, crabapple, English walnut, hawthorn, quince, pear

TIMING CONTROL

Monitoring with Pheromone Traps

Trap Placement

- Delta or wing style pheromone traps can be used to monitor adult activity (Fig. 5).

Fig. 5 Delta trap[2]

- Sex pheromone (codlemone) lures are used in traps to attract moths. There is a choice of lures available, in a rubber septum or membrane:

Lure Type	Sex Attracted	Orchard Type	Lure Longevity
1X (codlemone)	Males	Non-mating disrupted (MD)	30 or 60-day
10X (codlemone)	Males	MD	30-day
CM-DA combo (codlemone + pear ester)	Both	Both; primarily MD	60-day

- Place traps in orchards by first bloom or based on degree-day (temperature) accumulations (Table 1).
- Place traps within the upper third of the tree canopy (preferably 6 - 7 ft. high) making sure the trap entrance is not blocked and that it is parallel to the prevailing wind direction (Fig. 6).
- A minimum of two traps should be placed in each orchard. For orchards greater than 10 acres, place one trap for every five acres.
- Hang at least one trap on the edge and at least one near the center of the orchard to determine if moths are immigrating from outside sources and/or over wintering within the orchard. Suspected "hot spots" within the orchard should be monitored separately.
- Check traps every 1 - 2 days until the first moth is caught.

Biofix

- Biofix is a biological marking point from which the rest of an insect's development is measured. It is the beginning of consistent moth flight, or where at least two moths are trapped on consecutive nights.
- It is imperative to determine the date on which biofix occurs to accurately initiate the codling moth model.

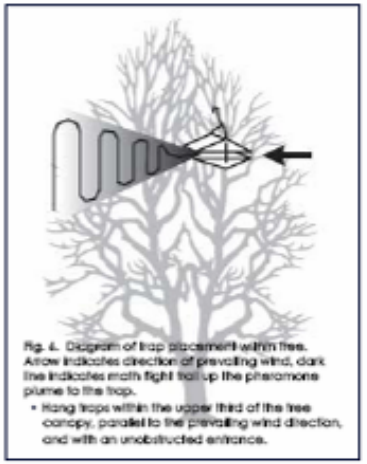


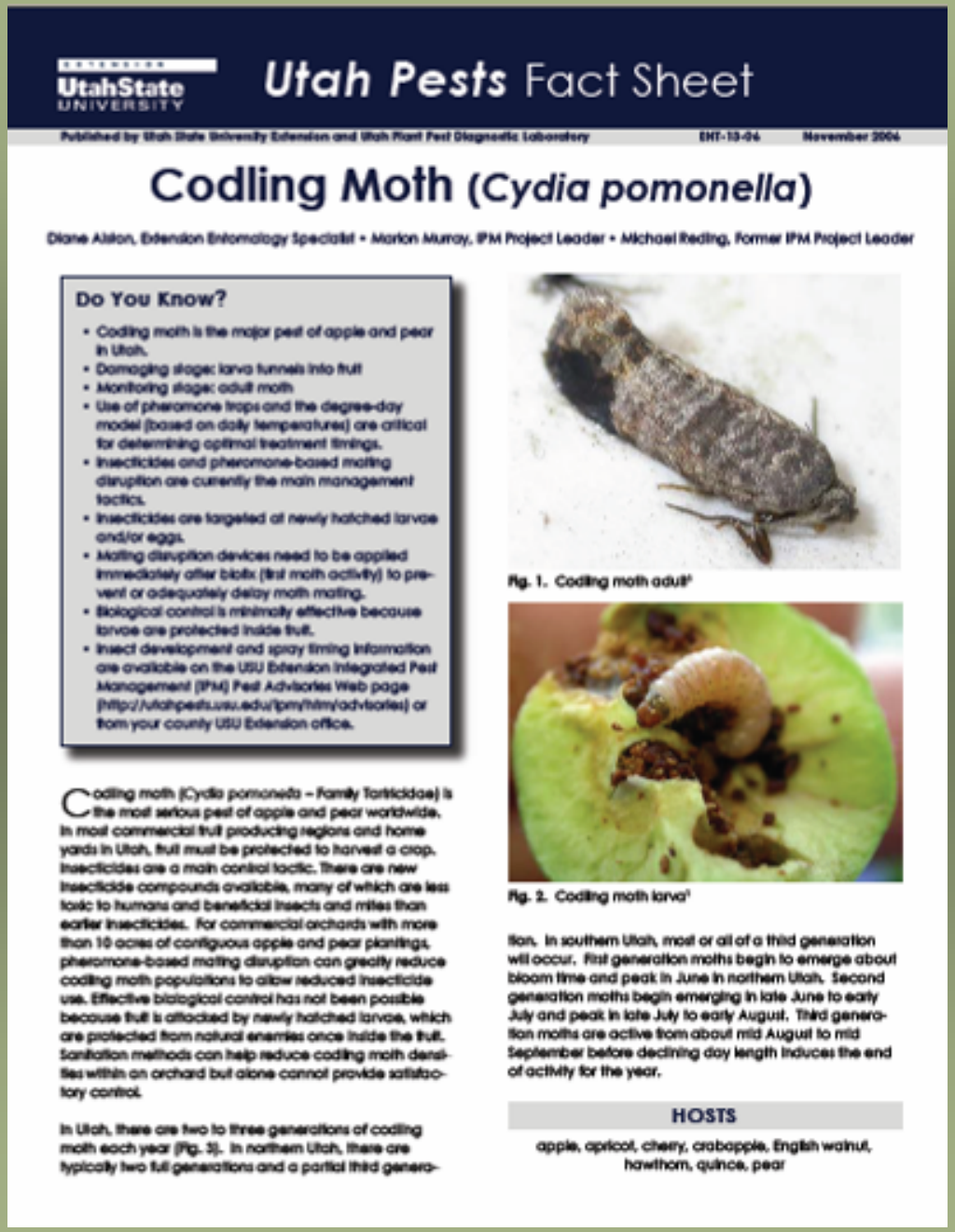
Fig. 6. Diagram of trap placement within tree. Arrow indicates direction of prevailing wind, dark line indicates moth flight trail up the pheromone plume to the trap.

- Hang traps within the upper third of the tree canopy, parallel to the prevailing wind direction, and with an unobstructed entrance.

Trap Servicing

- Trap catch data can be used to monitor moth emergence to start degree-day accumulations, to assist with determining optimal spray timings, to determine the relative size of the moth population, and to help in evaluating the success of your management program.
- Check traps weekly and record the number of moths caught (see Codling Moth Sampling Form, ENT-135F-6s). After recording, remove moths from trap.
- Change pheromone caps based on manufacturer's recommended product longevity and change sticky trap panels after catching 20 - 30 moths or after debris has collected on the surface.
- Zero trap catch does not necessarily mean there are no moths in the orchard. Evening temperatures below 60° F are not conducive to moth flight, and a lack of wind in the evening means the trap cannot create a pheromone plume, which lures moths inside (Fig. 6). Also, old or ineffective lures can cause zero trap catch.
- Do not cross-contaminate lures or traps between insect species. Do not handle or store unsexed pheromone lures together from more than one species. Do not reuse a trap that contained a pheromone lure from another species.
- Plan to use the same type of trap and lure from year to year so that you can compare results.

!Updated Fact Sheet!



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- Insecticides are targeted at newly hatched larvae and/or eggs.
- Mating disruption devices need to be applied immediately after biofix (first moth activity) to prevent or adequately delay moth mating.
- Biological control is minimally effective because larvae are protected inside fruit.
- Insect development and spray timing information are available on the USU Extension Integrated Pest Management (IPM) Pest Advisories Web page (http://utahpests.usu.edu/ipm/htm/advisories) or from your county USU Extension office.

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Fig. 1. Codling moth adult[1]

Fig. 2. Codling moth larva[1]

tion. In southern Utah, most or all of a third generation will occur. First generation moths begin to emerge about bloom time and peak in June in northern Utah. Second generation moths begin emerging in late June to early July and peak in late July to early August. Third generation moths are active from about mid August to mid September before declining day length induces the end of activity for the year.

HOSTS

apple, apricot, cherry, crabapple, English walnut, hawthorn, quince, pear

Updated the Codling Moth Fact Sheet

http://utahpests.usu.edu/ipm

Includes:

- Monitoring in MD orchards
- Lure types
- Timing insecticides that target multiple life stages
- Revised DD and “management events” table
- Insecticide options
- Mating disruption

Degree-day Model

The Degree-day Method

- The development of codling moth, like all insects, can be predicted based on accumulated heat over time, called degree days (DD). Use of the codling moth phenology model based on DD will help to more accurately time insecticide applications and reduce the number of applications to a minimum.
- Codling moth development occurs between the lower and upper temperature thresholds of 50° F and 88° F.
- Starting March 1 in northern Utah or January 1 in southern Utah, begin accumulating DD for an individual location by:
  - collecting representative daily maximum and minimum air temperatures and using the DD look-up table (Table 2), or
  - obtaining the information provided by USU Extension on the IPM Pest Advisories Web page (http://utahpests.usu.edu/ipm/html/advisories) or from your county extension office.
- Place pheromone traps in orchards when 100 DD have accumulated. The first moths are expected by 150 - 200 DD.
- Once biofix (first consistent moth catch) has occurred, accumulated DD are reset to zero (Table 1).

Timing Sprays

- If mating disruption (MD, see page 6) is used in an orchard, dispensers should be hung immediately after biofix to prevent mating and egg-laying. Supplemental insecticide treatments are usually necessary even when MD is used. The first cover spray is often the most important to apply as this timing should suppress the first generation and thus the following generations.
- Depending on the type of insecticide used, the first cover spray should be applied as follows:

DD after biofix	Timing/Target	Examples
50 - 75	pre-egg-laying	Rimon
100 - 200	early egg-laying	Horticultural oil, Esteem, Intrepid
220 - 250	first egg hatch (emergence of larvae)	Assail, Asana, Calypso, Carbaryl, Diazinon, Guthion, Codling Moth Granulosis Virus, Imidan

- Reapply insecticides based on the residual period (i.e., protection interval) of the product used. Keep fruit protected throughout each generation (Table 1).
- As harvest date approaches, consider the pre-harvest interval (required time interval between insecticide application and harvest) in planning late season treatments.

Table 1. Major events in a codling moth management program, based on accumulated degree days

Degree Days	% Adults Emerged	% Egg Hatch	Management Event
100 *	0	0	• Place traps in orchards
150 - 200	first moths expected	0	• Check traps every 1-2 days until biofix is determined
First Generation			
0 (biofix)†	first consistent catch	0	• Reset degree days to 0
50 - 75	5 - 9	0	• First eggs are laid • Apply insecticides that need to be present before egg-laying
100 - 200	15 - 40	0	• Early egg-laying period • Apply insecticides that target early egg-laying period
220 - 250	45 - 50	1-3	• Beginning of egg hatch • Apply insecticides that target newly hatched larvae
340 - 660	67 - 95	12 - 80	• Critical period for control, high rate of egg hatch • Important to keep fruit protected during this period
920	100	99	• End of egg hatch for 1st generation
Second Generation			
1000 - 1050	5 - 8	0	• First eggs of 2nd generation are laid • Apply insecticides to target early egg-laying
1100	13	1	• Beginning of egg hatch • Apply insecticides that target newly hatched larvae
1320 - 1720	46 - 93	11 - 71	• Critical period for control, high rate of egg hatch
2100	100	99	• End of egg hatch for 2nd generation
Third Generation			
2160	1	15	• Beginning of egg hatch • Keep fruit protected through September 15 • Check pre-harvest interval of material used to ensure that final spray is not too near harvest.

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

† Biofix is when at least 2 moths are caught on consecutive nights.

Major events in a codling moth management program, based on accumulated degree-days (DD)

Recommended timing for insecticides based on their mode of action

2006 was a tough year for codling moth injury

- High populations
- Even with MD, supplemental insecticide sprays were needed
- Resistance & cross-resistance to insecticides
- Hot weather, 3 generations
- Insecticide timing issues
- Full monitoring program!
- No room for error

Key Points of Interest in Codling Moth Life History

- Spend the winter as full-grown larvae in silken cocoons under bark
- In the spring, they pupate and emerge as adult moths – delayed dormant spray is not effective
- Use of pheromone traps & the degree-day model are critical for determining optimal treatment timings

Key Points of Interest in Codling Moth Life History

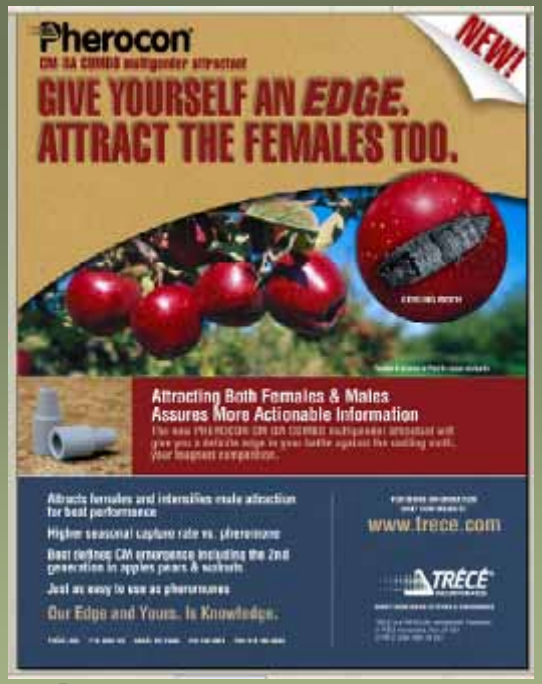
- Eggs are laid on leaves and fruit
- Within 24 hr of hatching, larva can enter fruit
- Insecticides target eggs & young larvae
- Mating disruption can help lower populations

CM Degree-Day Model

Major events in codling moth management. Timing of events is based on degree-day accumulations* and first activity of adults.	
Degree-Days (DD)	**Management Event**
100	Place traps in orchards
150-200 Reset DD to 0 at biofix	First moths expected, check traps every 1-2 days until biofix is determined
50-75 DD after biofix	Pre-egg-laying Rimon
100-200 DD after biofix	Early egg-laying Horticultural oil (1%), Esteem, Intrepid
220-250 DD after biofix	First egg hatch Assail, Calypso, Asana, Warrior, Guthion, Imidan, CM Virus
340-640 DD after biofix	Peak egg hatch (12-80%) Critical fruit protection period
*Based on 50°F lower threshold and 88°F upper threshold for development. Begin accumulating DD Mar. 1.	

Mating Disruption

- Appropriate for orchards ≥ 10 acres or in contiguous blocks
- Lower codling moth population to allow fewer and lower toxicity insecticides
- Does not eliminate insecticides in most cases
- Continuous adult monitoring is critical



New trap lure for monitoring in MD orchards

Cultural & Mechanical Controls

- Fruit thinning
  - Eliminate clusters/touching fruit
- Sanitation
  - Destroy June-drop fruit
  - Eliminate pupation sites (bins, debris)
  - Destroy cull piles
  - Eliminate outside sources
- Trunk banding
  - Corrugated cardboard bands
    - May to late June (1st gen.)
    - August to late October (2nd – 3rd gen.)

New CM Products

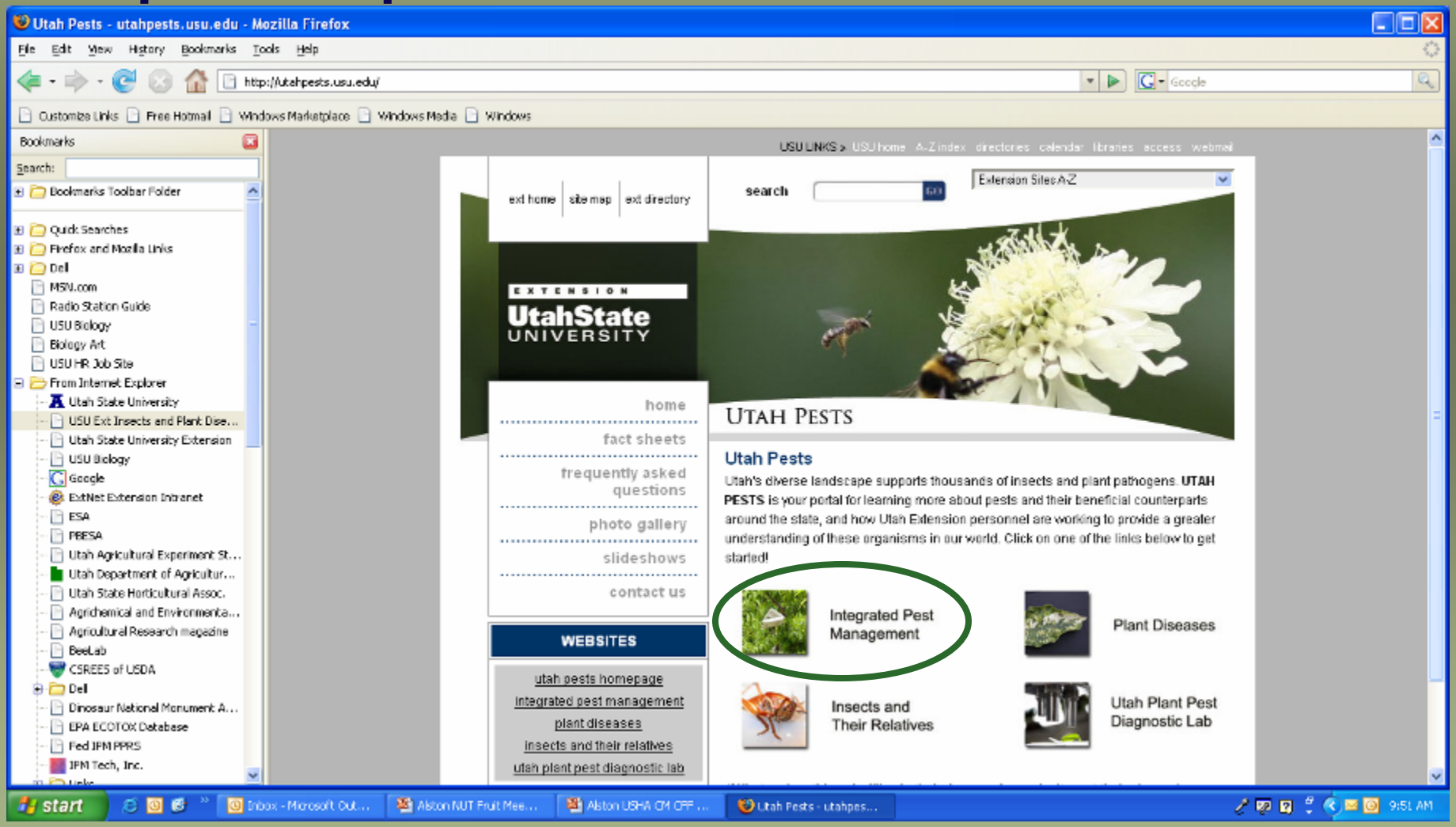
- Insecticides (broad spectrum)
  - Battalion (deltamethrin) – 5th gen. synthetic pyrethroid, less mite flare, Arysta LifeScience Corp.
  - Altocor (rynaxypyr) – new class, “anthranilic diamide”, interferes with calcium gates in muscles, affects movement, DuPont Crop Protection
  - Delegate (spinetoram) – new spinosyn insecticide, Dow AgroSciences
  - Belt and Synapse (flubendiamide) – new class, “phthalic acid diamides”, disruption of cellular calcium balance, Bayer CropScience

New CM Products

- Pheromone MD products
  - CideTrak DA-Combo dispenser – pear ester + pheromone in dispenser, Trece
  - CideTrak DA MEC – micro-encapsulated, sprayable pear ester MD product, Trece
  - SPLAT – flowable pheromone dispenser, MD and attract-&-kill if insecticide added, ISCA Technologies
  - Pheromone flakes & fibers – applied in sticky glue, not commercially available

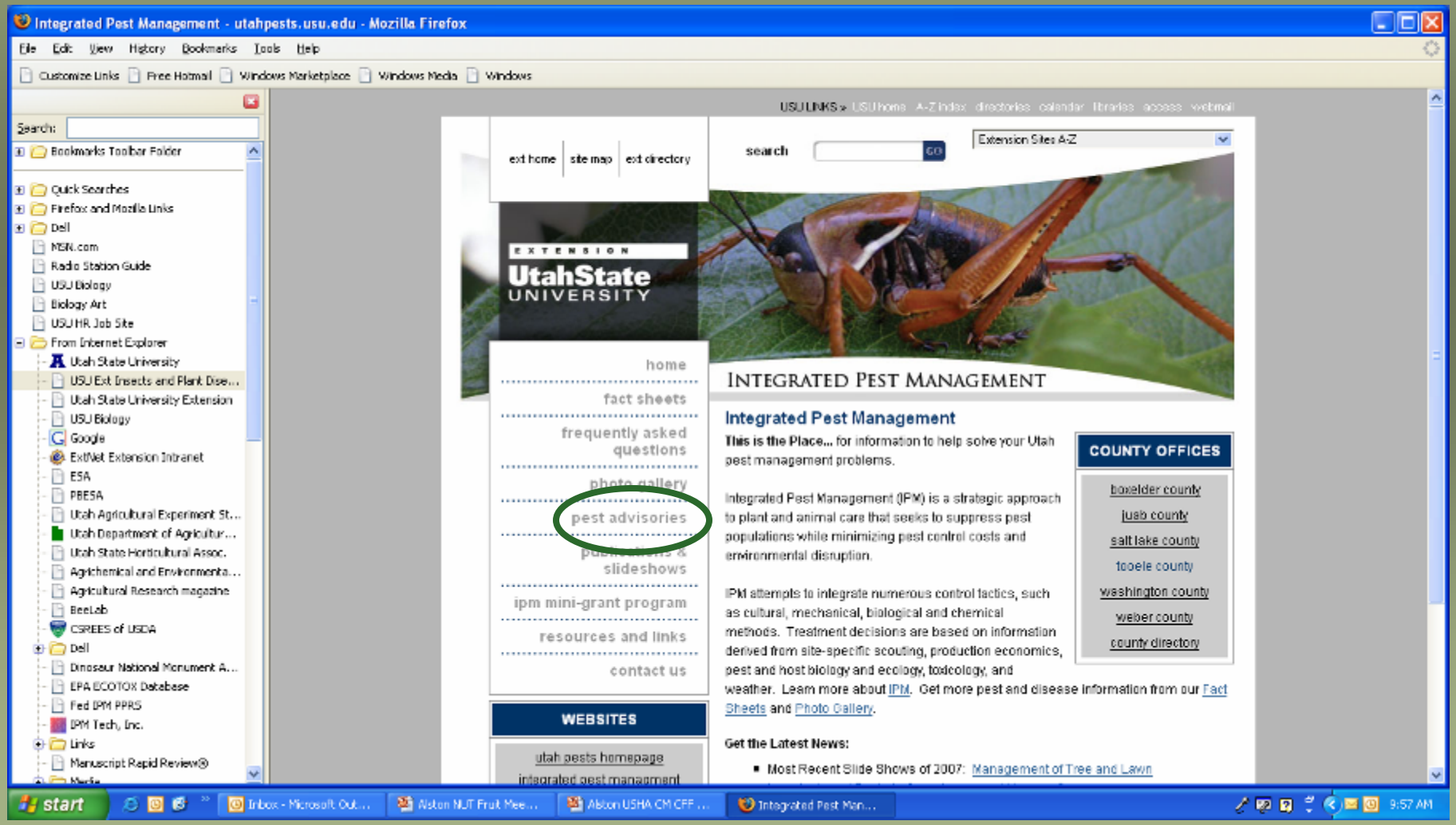
Finding Information on our Web Sites

http://utahpests.usu.edu



USU IPM Web Site

http://utahpests.usu.edu/ipm



IPM Pest Advisories

Utah State University Extension
extending knowledge to you

Tree Fruit IPM Advisory: July 5th, 2006

Past IPM advisories are archived at:
http://extension.usu.edu/cooperative/ipm/index.cfm/cid.610/

**********New: Alert**********

Please send in any biofix date information for greater peachtree borer (GPTB). No adults have been caught yet at the USU Kaysville Research Farm.

**********Insect Advisory**********

Due to the Fourth of July holiday this week, degree-days (DDs) will be updated on Wed. and Fri. This week's advisory is brief. View the updated DDs and predictions for beginning of egg hatch of the 2nd generations of codling moth and peach twig borer at: http://extension.usu.edu/cooperative/ipm/index.cfm/cid.645/ (Select 2nd Generation CM and PTB in the right-side column).

CODLING MOTH (Apple and Pear): Larval emergence for the 1st generation is now completed in warmer northern Utah sites. Those sites where 1st generation is not yet completed will end within the next week (West Mountain- Jul 4, Alpine- Jul 6, Logan- Jul 12, North Logan- Jul 14). Keep fruit protected through the end of the generation. Larval emergence for the 2nd generation is underway (1100 DDs correlates to 1% egg hatch) or will be later this week in warmer northern Utah locations (Salt Lake City- Jul 2, Perry- Jul 4, Genola- Jul 7, Payson- Jul 8, Provo- Jul 8, Santaquin- Jul 8, Kaysville- Jul 9). Ensure that fruit is protected with mating disruption and/or insecticides as 2nd generation eggs begin to hatch.

PEACH TWIG BORER (Peach, Nectarine, and Apricot): Emergence of 1st generation larvae is completed in all northern Utah sites with monitoring information. Egg hatch of the 2nd generation is predicted to reach 5%, the point we recommend applying a cover spray, from July 12-21 (see http://extension.usu.edu/cooperative/ipm/index.cfm/cid.645/ for dates for individual monitoring sites; select 2nd generation PTB). No sprays are necessary until then.

Refer to past advisories for a listing of insecticides recommended to control codling moth and peach twig borer in commercial and home orchards.

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Codling Moth (CM) Biology and Management 09/25/2006 12:23 PM

Codling Moth Biology and Management

Degree-Day Totals and Spray Dates (current as of midnight, 7/5/06)

The spray dates in each table are based on the developmental biology of codling moth. The "Projected Larval Emergence" is the period of time in which codling moth larvae (caterpillars) are likely to be hatching from eggs and looking for fruit. Sprays that are targeting the caterpillars will be most effective if applied during this period.

The treatment dates are predictions using site-specific weather data, short-term weather forecasts, and 30-year temperature averages. The "Onset" date represents approximately 220 DDs (degree-days) accumulated from the biofix date, which should correspond to 1% egg-hatch (1% of the 1st generation eggs have likely hatched at this point). The "End" date represents approximately 920 DDs from the biofix, which should correspond to 99% egg-hatch. The projected Onset and End dates of the spray period will be updated as current weather data become available.

1ST Codling Moth Generation:

Unless otherwise noted, all information is based on weather readings through 7/5/06.

Boxelder County	Degree-Day Totals			Larval Emergence	
Location	DDs since March 1st	Biofix Date	DDs since Biofix	*Projected* Onset	*Projected* End
Perry	1327	May 1	1135	May 19	June 27

Cache County	Degree-Day Totals			Larval Emergence	
Location	DDs since March 1st	Biofix Date	DDs since Biofix	*Projected* Onset	*Projected* End
Logan (bench)	976	May 5	839	May 26	July 10
North Logan	968	May 5	814		July 12

Davis County	Degree-Day Totals			Larval Emergence	
Location	DDs since March 1st	Biofix Date	DDs since Biofix	*Projected* Onset	*Projected* End
Kaysville	1262	May 10	1025	May 23	July 1

Salt Lake County	Degree-Day Totals			Larval Emergence	
Location	DDs since March 1st	Biofix Date	DDs since Biofix	*Projected* Onset	*Projected* End

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