NEWA Quick Guide for Apple Insect Pests

NEWA | Network for Environment and Weather Applications

New York State Integrated Pest Management

Cornell CALS College of Agriculture and Life Sciences

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INTRODUCTION

The purpose of this guide is to provide a quick overview for using NEWA models pertaining to insect pests of apples. For each model discussed, it includes an **Overview** including model inputs and outputs, **Key Management Timings** for the particular pest, and a **Management Guide** with the detailed pest phenology and management recommendation outputs that you can expect from the model during the corresponding times of the season.

More information and video tutorials on how to use NEWA models are available at the New York State Integrated Pest Management (NYSIPM) Help Desk below.

https://help.nysipm.org/hc/en-us/sections/17011505301783-Apple-Insect-Disease-and-Crop-Management-Forecasts

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KEY TERMS

Biofix – A biological indicator, observed in the field/orchard, used to start model calculations. Many models use a unique biofix, which must be recorded at the particular location of interest. Examples include 50% green tip, first sustained moth trap catch. Specific biofixes used in NEWA can be found online: https://newa.cornell.edu/default-biofix-dates/

Degree Days (DD) – A method of tracking ambient temperature and heat accumulation over a period of time. Typically used to predict plant or insect activity. DD calculations use a base or threshold temperature. Methods of calculation are reviewed in this video online https://youtu.be/NwyBAcvbpUs

Base Temperature – Threshold temperature below which degree days are not accumulated. Many insects are not active below certain temperatures, so we do not include temperatures in DD accumulation. 43 and 50 F are commonly used in NEWA models.

1st sustained trap capture – For insect monitoring, mark 1st capture when you have captured more than 1 moth two weeks in a row. Throughout this guide, "1st trap capture" and "1st sustained trap capture" are synonymous.

Integrated Pest Management (IPM) – A science-based approach to managing pests (insects, diseases, wildlife, weeds) sustainably, using an array of complementary methods, which minimizes risk to the environment, human health, and economics

PLUM CURCULIO

https://newa.cornell.edu/plum-curculio

This tool uses base 50° F BE degree days to estimate the emigration of plum curculio (*Conotrachelus nenuphar*) into the apple orchard following petal fall, the need for treatment and when treatment can cease.

- **Input**: Petal Fall date
- **Output**: DD Base 50 post Petal Fall date

CRITICAL MANAGEMENT TIMES

Petal Fall	Adults move into orchard and begin ovipositing. An insecticide should be applied at this time, targeting adults.
Post Petal Fall	Activity is highly dependent on temperatures. Adults remain active for approximately 308 DD Base 50 after petal fall
10-14 day interval post-PF	Maintain coverage during this time. Adults do not usually feed when nighttime temperatures are below 50F

MANAGEMENT GUIDE

	Pest Stage	Management
Dormant through **Tight Cluster**	**Adults still overwintering** No plum curculio activity at this time.	No control measures are recommended at this time because most adults have not yet emerged and will escape residual effectiveness of most insecticides.
Pink	**Adults move into orchard** Adults usually emerge from overwintering quarters during the pink bud state of apples and begin to immigrate into the edges of commercial orchards.	No control measures are recommended at this time because fruit has not yet begun to develop and reach a susceptible stage for injury from plum curculio adults.
Bloom	**Adults in apple trees** Adults can be present in apple trees during bloom but do not begin to feed on or oviposit in fruit until petal fall.	No control measures are recommended at this time because fruit has not yet begun to develop and reach a susceptible stage for injury from plum curculio adults.
Petal Fall	**Adults ovipositing** At petal fall, fruit becomes susceptible to fruit injury from plum curculio adults. The adults may damage fruit directly by feeding or females may oviposit in the developing apples.	Apply a control spray of a broad spectrum insecticide at petal fall to control any plum curculio adults that may be present in the orchard. Plum curculio only needs to be controlled until 308 DD have accumulated after petal fall. Sprays applied at this time may also help control internal Lepidoptera, European apple sawfly, and the first generation of white apple leafhoppers and spotted tentiform leafminers.
	Plum curculio (PC) adults will continue to damage fruit and may be moving among trees. PC activity is highly dependent upon temperatures, particularly at night when adults are most active. PC usually do not feed or oviposit when nighttime temperatures are below 50°F. If the weather is extremely warm after petal fall, the oviposition cycle may be completed in 2 weeks. In cooler seasons, PC may continue to oviposit for 4-6 weeks.	A petal fall spray should control plum curculio (PC) for about 10-14 days. Incidence of observed PC damage is highly variable among different orchards. PC damage usually occurs primarily along the edges of commercial orchards, and noticeable damage occurs in the same locations in orchards year after year, regardless of treatment levels. Therefore, the potential for damage in any particular orchard can be predicted from past observations. Usually, a post-petal fall spray for control of PC is not necessary in low-pressure orchards in which no damage has been observed in the past. In high-pressure orchards, additional sprays along the perimeter of the orchards should be applied until the oviposition model predicts that control is no longer necessary, which is when at least 308 DD have accumulated after petal fall.

CODLING MOTH

https://newa.cornell.edu/codling-moth

This tool predicts codling moth (*Cydia pomonella*) life stages with base 50° F BE degree days to identify treatment windows with management guidelines.

- **Input:** First sustained trap capture of 1st generation (and 2nd generation)
- **Output:** DD Base 50 since first trap capture

CRITICAL MANAGEMENT TIMES

1st generation

- **1st trap capture** – biofix for model
- **50 DD after 1st trap capture** – Egg laying begins
  - **50-75 DD** – Apply insecticides that need to be present before egg laying.
  - **100-200 DD** – Apply insecticides that target early egg laying
- **220 DD after 1st trap capture** – first eggs hatch
- **250 DD after 1st trap capture** – apply first spray for control of overwintering CM
- **10-14 days after the initial spray** – Apply a second spray, following the spray that was timed at first hatch

2nd generation

- **1st trap capture** – biofix for model, repeat above
- **OR you can use the Cumulative DD from first generation biofix to predict 2nd generation activity**

MANAGEMENT GUIDE

	Pest Stage	Management
Dormant through **Tight Cluster**	**Overwintering in pupae stage** No codling moth flight is expected.	Pheromone traps should be in place before the first apple blossoms open. Mating disruption dispensers should also be put in the orchard before the first blossoms open for seasonal disruption programs.
Bloom	**First generation moths emerge** First catch of the adults from the overwintering generation is expected (usually coincides with first bloom of 'Red Delicious' apples).	No insecticides need to be applied until eggs begin to hatch.
	Moths flying & first eggs laid First eggs are laid at about 50 DD and the first eggs usually hatch after about 220 DD.	Apply insecticides that need to be present before egg laying at about 50-75 DD. Apply insecticides that target early egg laying period at 100-200 DD.
	Moth catches increasing & eggs begin to hatch Eggs usually begin to hatch about 220 DD after the first catch, and catches of adults should be increasing in pheromone traps.	Apply the first spray for control of overwintering CM at 250 DD after first catch. In some seasons, Plum curculio will still be active at this time and a broad spectrum material should be selected to control both of these pests at this time in high risk PC orchards. If internal worm damage has been observed in past years in an orchard, CM populations may be resistant to organophosphate and synthetic pyrethroid insecticides and other classes of materials may be more effective.
	Moth flight peaks & majority of eggs hatch Adult flights are relatively heavy during this period and the majority of eggs are likely to hatch, so control is critical at this time.	Apply a second spray 10-14 days after the initial spray that was timed at first hatch, to provide protection during this critical time period. In high-pressure orchards, it may be particularly important to apply other classes of materials to replace organophosphates or synthetic pyrethroids.
	1st moth flight over & egg hatch complete Egg hatch of the first generation of CM is almost completed.	It is too late to apply control sprays at this time because egg hatch is almost over and late sprays will not prevent fruit damage that has occurred earlier in the season. If fruit has become infested with CM during the first generation, it will make subsequent control more difficult later in the season; most apples infested by larvae at this time will drop prematurely and will not be detected at harvest.
	2nd generation moths emerge The flight of second generation CM usually starts during this time.	Insecticides should be applied when the eggs from the second generation of CM begin to hatch, which usually occurs about 250 DD after the moth flight begins.

ORIENTAL FRUIT MOTH

https://newa.cornell.edu/oriental-fruit-moth

This degree day tool (base 45° F BE) tracks oriental fruit moth (*Grapholita molesta*) development across three generations, identifies treatment windows, and provides management information.

- **Input**: 1st trap catch
- **Output**: DD since 1st trap catch

CRITICAL MANAGEMENT TIMES

1st generation

- **1st sustained trap capture** – biofix
- **Petal fall** – eggs usually begin to hatch, an insecticide should be applied targeting egg hatch
- **10-14 days after petal fall** – second spray should be applied

2nd generation

- **1st trap capture** – biofix. Flight is expected at about 1000-1400 DD base 45F from January 1.

MANAGEMENT GUIDE

	Pest Stage	Management
Dormant Silver Tip Green Tip	**OFM are overwintering as pupae** No OFM flight is expected.	Pheromone traps and mating disruption dispensers should be deployed at the beginning of the pink bud stage.
Half-Inch Green Tight Cluster Pink Bloom	**First generation of moths emerge** First catch of moths from the overwintering generation is expected. Flight of OFM usually begins when trees are in the pink or bloom bud stages.	No insecticides need to be applied until eggs begin to hatch; since OFM flight usually begins at bloom, it is not possible to apply an initial spray to kill adults.
Petal Fall	**Moths flying and first egg hatch** OFM eggs usually begin to hatch at petal fall.	The normal petal fall spray should control OFM larvae hatching early in the season. PC is also active at PF, so broad spectrum materials will be needed at this time to control this pest. If you have had a past history of damage from OFM in an orchard and if trap catches are high (>10/trap/week), it is possible that local OFM populations are resistant to organophosphates and/or pyrethroids. Therefore, you may want to use another class of chemical at petal fall for OFM control. Although first generation OFM larvae can damage fruit, particularly in orchards with high pest population densities, most larvae from this generation in apples will infest only apple shoots. Therefore, the primary reason to control the first brood is to cut down on resident populations in the orchard that could lead to more severe infestations later in the season.
	Moths flying & 50% of eggs have hatched Moths are still flying and usually about 50-60% of OFM eggs from the first generation have hatched.	Check the time elapsed after petal fall to determine the exact timing of this second spray. This second spray should be applied at about 10-14 days after petal fall. This second spray against the first generation of OFM is particularly important in high-pressure orchards (past history of OFM fruit damage or high pheromone traps catches, (>10/ trap/ week) to control the remainder of hatching larvae. If this spray is applied at the normal time of a first cover spray (10-14 days after petal fall) it will also control early hatching CM larvae from the first flight of adults. Also, plum curculio may still be active at this interval after PF in cool, rainy seasons.
	1st moth flight ends and hatch over The first flight of moths is diminishing and the start of the second flight of OFM is expected at about 1000-1400 DD base 45F from January 1.	It is too late to apply control sprays against the first generation of OFM larvae.
	2nd generation moths emerge. The second flight of OFM usually starts in late June to early July in western NY.	It is too soon to apply a control spray against the second generation of OFM. The initial spray should be applied when eggs begin to hatch.

OBLIQUEBANDED LEAFROLLER

https://newa.cornell.edu/obliquebanded-leafroller

Using base 43° F BE degree days, this tool delineates obliquebanded leafroller (*Choristoneura rosaceana*) development, sampling strategies, and management guidelines.

- **Input:** 1st trap catch
- **Output:** DD Base 43 since 1st trap catch

CRITICAL MANAGEMENT TIMES

Overwintering generation

- **Pink** – Sample starting at the pink bud stage. A control spray can be applied during pink if larval populations exceed a threshold of 3% clusters infested with live larvae.
- **Bloom** – A possibly management option is to apply Bt at this time if sampling exceeds 3% of clusters
- **Petal Fall –** Apply a control spray as soon as possible after petal fall to control overwintering larvae. Research studies in NY have shown that applying a single insecticide spray at either pink or petal fall is just as effective in controlling overwintering larvae and early fruit damage as applying two sprays (at pink and petal fall).
- **June 1 –** Deploy pheromone traps to monitor for 1st generation

First Generation

- **1st trap catch** – biofix
- **350 DD** – egg hatch, apply an insecticide at this time targeting larvae in orchards with a history of OBLR
- **10-14 days later** – apply an insecticide at this time targeting larvae
- **600-700 DD –** monitor terminals for larvae (to verify models) to determine if infestation requires management with an additional insecticide application

Second Generation

- **Additional summer monitoring** – Continue to inspect fruit clusters to determine if small larvae are present and fresh feeding has occurred.
- **2nd generation larvae and fruit damage** – if these are prevalent, a treatment of any material that is effective against the first summer generation of larvae can be applied.

Sampling form: https://file.nysipm.org/newa/OBLR-sampling-form.pdf

MANAGEMENT GUIDE

	Pest Stage	Management
Dormant through **Tight Cluster**	**Overwintering larvae emerge** Overwintering OBLR larvae usually begin to emerge at the half-inch green growth stage.	No control measures are recommended at this time because most overwintering larvae have not yet emerged and will escape residual effectiveness of most insecticides.
Pink Bud	**Overwintering larval emergence almost over** Almost all overwintering larvae have emerged by the end of the pink bud stage.	Overwintering larvae can be sampled starting at the pink bud stage. A control spray can be applied during pink if larval populations exceed a threshold of 3% clusters infested with live larvae.
Bloom	**Overwintering larvae complete emergence** Emergence of overwintering larvae is completed by the end of bloom.	Larval populations can be monitored by sampling blossom clusters. Click here for sampling form. Bt can be applied during bloom if larval populations exceed threshold levels. All other insecticides cannot be applied until petal fall.

Petal Fall	**Overwintering larvae feeding** Overwintering larvae begin to feed on developing fruit and may cause some damage, although many fruit damaged at this time will drop off of the tree prematurely and not result in fruit damage at harvest. Fruit damage from overwintering larvae is usually relatively low (less than 5 percent).	Apply a control spray as soon as possible after petal fall to control overwintering larvae. Research studies in NY have shown that applying a single insecticide spray at either pink or petal fall is just as effective in controlling overwintering larvae and early fruit damage as applying two sprays (at pink and petal fall). Most currently available insecticides usually only reduce fruit damage from overwintering larvae by 40-60%. Usually, fruit injury from overwintering larvae is less than 5% at harvest, even if no control sprays are applied. Some studies have shown that controlling the overwintering larvae will reduce numbers of subsequent summer generation larvae and the average damage from the summer generation is usually lower than when control of overwintering larvae is omitted, particularly when large areas are treated. Plum curculio may also be a problem in some orchards at this time and many materials that are effective against OBLR do not control this pest effectively. Pheromone traps to monitor the first flight of OBLR should be deployed by June 1st.
	1st generation moths flying & laying eggs Adults are still flying and laying eggs. Peak flight usually occurs within two weeks after the first adult is captured.	No control measures are recommended at this time, because eggs have not yet begun to hatch, this occurs at approximately 350 DD base 43F after first trap catch. It is also too early to sample growing terminals to estimate larval populations.
	First egg hatch First hatch of summer OBLR eggs. Adult catches in pheromone traps are near or past peak numbers.	In order to verify model predictions, monitor growing terminals at 600-700 DD base 43F after biofix to check for the detection of the first summer generation larvae. It is too early now to monitor populations of summer larvae at this time to determine if control sprays are necessary because most eggs will hatch later during the summer. However, applying protective sprays with the first spray timed to coincide with the first hatch of larvae at approximately 350 DD base 43F after biofix followed by a second spray 10-14 days later are recommended in orchards that have had a past history of severe OBLR fruit damage or if populations of overwintering larvae were high.
	Peak egg hatch Peak egg hatch, approximately 25% of total eggs have hatched by this time.	It is still too early to sample for larvae in orchards that are being monitored to determine if summer control sprays are necessary because most egg masses still have not hatched. Residual activity from an initial protective spray will control hatching larvae at this time.
	Egg hatch half over Approximately half of egg masses have hatched at this time.	Summer larvae can be sampled in growing terminals at this time to determine if a control spray is necessary. Sampling at this time can determine the need for additional sprays if an initial protective spray has already been applied.
	Larvae damaging fruit Fruit damage is starting now, and will rapidly increase if larvae have not been effectively controlled.	The second summer control spray should provide adequate control of the later hatching summer generation larvae. A third spray may be recommended if earlier materials have not been effective and larvae populations are extremely high.
	1st flight almost over, large larvae Flight of the first summer generation of adults is now diminishing.	It is too late to apply control sprays for the summer generation of OBLR larvae. If larvae have not been controlled by earlier treatments, fruit injury will already be substantial and remaining older larvae are less susceptible to insecticides.
	2nd flight moths emerge Second flight of OBLR is now beginning.	Control of the second generation of OBLR larvae is not usually necessary if the first summer generation of larvae has been effectively controlled or if populations are low.
	2nd generation peak flight Peak flight of the second generation of adults. Larvae from the second generation are hatching and small larvae may be present. These larvae will feed for a short period of time and then go into overwintering habitats.	Although no formal sampling protocols have been developed, fruit clusters can be inspected to determine if small larvae are present and fresh feeding has occurred. If it appears that second generation larvae and fruit damage are prevalent, a treatment of any material that is effective against the first summer generation of larvae can be applied.
	2nd generation flight declining Flight of the second generation is diminishing.	It is too late to apply control sprays for the second generation of OBLR larvae at this time because many larvae have already stopped feeding and have gone into overwintering quarters.
	Moth flight over, larvae hibernating OBLR season is over.	Control sprays are no longer necessary.