Blueberry Export to Korea

1. Orange tortrix, *Argyrotaenia citrana*

Biology and ecology

A. citrana is adapted to cool maritime climates such as the caneberry-growing areas in the Willamette Valley in Oregon. The number of generations per year is estimated to three generations in caneberry-producing areas in Oregon.

Larvae overwinter in grape clusters on the ground, under leaf litter, or on weedy herbaceous plants in vineyards such as curly dock, mustard, pigweed and California poppy. On apple, larvae overwinter in dead leaves remaining on branches and buds. On raspberry, larvae overwinter under buds on canes and under dead leaves tied up on the trellis with trailing berry canes. The species may overwinter as small or large larvae or pupae. Larvae begin feeding on developing leaves in late March and April completing development in late May. Pupation generally occurs at the larval feeding site in webbed leaves and in trash on the ground. Adults emerge in June and early July laying eggs in flat masses in smooth canes and on leaves. Eggs are laid in clusters on smooth surfaces, such as the upper side of leaves or fruit. Moths are negatively phototropic and remain in vegetation during the day.

A. citrana has five larval instars and larval development requires 503 degree-days above a lower threshold of 5°C. Larvae are easily reared on artificial diets. Adult emergence in Oregon occurred from 300 to 700 degree-days accumulated from 1 January. Cumulative male emergence preceded female emergence by 50 to 80 degree-days. Following the time period of peak mating, male moths move widely among host crops within a region.

A. citrana does not diapause and, in the milder areas of its geographical range, it overwinters as both pupae and larvae. *A. citrana* larvae reportedly feed on dead leaves tied on trellises in caneberry fields during the autumn and early spring months. The variation in levels of nitrogen and moisture content among these dead plant parts and the new plant growth in the spring probably contributes to the extended adult emergence period.

Distribution

From southern California into western Oregon, Washington and BC. Adults fly, and young larvae can be transported short distances on silken strands by the wind.

Hosts

A. citrana has a very broad crop and non-crop host range. Basinger (1938) listed 39 species of plants and Coop (1982) tabulated over 80 species of host plants. *A. citrana* was originally reported in southern California as a pest of citrus, and has subsequently been reported on a number of crops in California, Oregon and Washington. These include various greenhouse plants, apple, Monterey pine (*Pinus radiata*), citrus, apricot, avocado, grape, caneberry (*Rubus* spp.) in Washington and Oregon, and blueberry.

Other hosts
Raspberry, blackberry, boysenberry, loganberry, youngberry, blueberry, salmonberry, apple, peach, grape, holly, Oregon grape

Damage
Larvae feed on developing buds and leaves of cane fruits, tree fruits, ornamentals and florist crops in the spring. Larvae web leaves together and feed on terminal growth. Later in season, larvae feed on developing berries and fruit tissues, making the berries unacceptable for fresh market.

Identification
Confusion with the correct identification of both the adult and larval stages of *A. citrana* can occur in both caneberry and apple. The tortricid moth, oblique-banded leafroller, *Choristoneura rosaceana* can be trapped in sticky traps baited with the sex pheromone blend of *A. citrana* and is commonly found in caneberry. Yet, these two species are easily differentiated. The wingspan of *C. rosaceana* males is approximately 50% larger than *A. citrana* and has two distinguishing brown oblique bands on the forewing. Similarly, *C. rosaceana* larvae are distinctive from *A. citrana* due to their larger size and dark brown or black head capsule. The tortricid, *Pandemis pyrusana* commonly occurs in apple orchards in coastal California. Adult *P. pyrusana* are similar in appearance to *C. rosaceana* and are not attracted to the sex pheromone of *A. citrana*. However, *P. pyrusana* larvae may be similar in appearance to *A. citrana*. Fruit injury by these two species is often grouped together as 'skinworms'.

Field Monitoring/Economic Threshold Levels
A. citrana populations are monitored with sex pheromone-baited sticky traps and larval sampling. Thresholds were established in caneberry based on moth catch, previous pest history, and presence of current larval populations. The relationship of moth capture in sex pheromone-baited traps and moth emergence has been well studied with *A. citrana*. Efforts to improve the correlation of moth catch with larval populations in apple were not successful.

Check blueberry buds for potential damage from larval feeding

Larval populations can be assessed by determining the proportion of infested shoot terminals, infested grape clusters, or the number of infested terminals per sampling time unit.

Trap design
Yellow Delta traps can be used for monitoring *A. citrana* populations. Commercially available pheromone lures can be purchased at ARBICO Organics (no endorsement or guarantee by ODA): arbivo-organics.com/product/Orange-tortrix-Argyrotaenia-citrana-pheromone/. Another supplier is Russell IPM (russellipm-agriculture.com). A trap density of one trap per 10 acres is recommended.

Management

Chemical Control

A. *citrana* is a minor pest in a majority of California coastal apple orchards, Salinas Valley grape vineyards and Pacific Northwest caneberry fields. However, fruit injury in apple has become more widespread in areas where sex pheromones have been tried for mating disruption of codling moth, *Cydia pomonella*. A variety of materials are available to manage *A*. *citrana*, but historically organophosphate and microbial (*Bacillus thuringiensis*) insecticides have been used. Sprays are applied against either the spring or summer larval populations. *A*. *citrana* populations in caneberry can build to very high levels and are typically managed with *B*. *thuringiensis* insecticides in early summer, and synthetic pyrethroid insecticides are applied as a general clean-up spray prior to harvest in most orchards.

The use of sex pheromones for mating disruption of *A*. *citrana* has been evaluated in replicated small plots and in a limited number of grower's fields. Use of a generic, single sex pheromone component, (z)-11-tetradecenyl acetate [Z11-14:AC], which has been used to manage a suite of tortricid pests in apple was not as effective as *A*. *citrana*'s natural sex pheromone 15:1 blend of Z11-14:AC and (Z)-11 tetradecenal. Similar results have been generated with both hand-applied dispensers and sprayable formulations. However, the level of control achieved with sex pheromones has not been ruled adequate in fields with high population densities. In addition, due to the low number of insecticides used to manage *A*. *citrana* and the continued need to clean up arthropod contaminants prior to harvest, the adoption of mating disruption in caneberry is unlikely. However, the future development of a dual dispenser for codling moth and *A*. *citrana* in apple may occur.

Cultural Control and Sanitary Methods

A. *citrana* populations can be successfully managed in caneberry through overwintering cane management. Tying up of canes on trellis wires enhances winter survivorship of larvae. The mat of dead leaves and canes protects larvae from desiccation and freezing. Thus populations can be reduced by removing old canes in the fall, delaying cane tying until the majority of leaves have dropped, and by loosely tying canes on the trellis.

Several cultural practices are recommended to control *A*. *citrana* in apple. These include hand thinning of fruit clusters, removal of overwintering sites within the orchard such as apple mummies and regular cultivation, mowing, or herbicide use to remove weedy hosts. Similar cultural practices are also recommended to manage *A*. *citrana* in grape.

Growth Stages

Fruiting stage, Vegetative growing stage

A. *citrana* feeds both on vegetative structures and the surface of developing fruits.

Fruit: malformed skin**;** external feeding
Growing point: external feeding**;** distortion
Inflorescence: external feeding; webbing

Leaves: external feeding; leaves rolled or folded; webbing
Stems: external feeding

Agricultural Practices

Larvae can be dislodged from leaf feeding shelters and land in the picking flats during the harvesting of caneberry. Harvested fruit is then transported to storage and processing facilities situated usually within 100 km from the field. Larvae generally leave the containers of fruit during transport and those that remain are removed at the packinghouse. Procedures are maintained to minimize the possibility of any insect contamination of processed food products such as jams or syrups and are strictly enforced. Similar contamination of grapes can occur during harvest and larvae are removed along with damaged fruit during processing. Larvae feeding on the surface of apples do not pose a contamination problem for either the fresh or processing markets.

Removing dead leaves and trash following harvest may help reducing overwintering larvae. Also keeping adjacent land clean and removing weeds or brush can reduce overwintering population.

Plant Trade

Plant parts not known to carry the pest in trade/transport

Bark	Bulbs, Tubers, Corms, Rhizomes	Flowers, Inflorescences, Cones, Calyx	Fruits (inc. pods)
Growing medium accompanying plants	Leaves	Roots	Seedlings, micropropagated plants
Stems (above ground), Shoots, Trunks, Branches	True seeds (incl. grain)	Wood	

Natural Enemies

A number of hymenopteran and dipteran parasitoid species are important natural enemies throughout the range of *A. citrana*. *Exochus nigripalpus subobscurus* and *Apanteles aristoteliae* have been reported as the most important parasitoids of *A. citrana* larvae in California. *Meterorus argyrotaenia* was reported to be exerting up to 100% control of *A. citrana* in Washington raspberry fields during 1956-7. Thirteen parasitoid species from *A. citrana* from over 2000 larvae were collected from eight fields in Oregon during 1983-84. The apparent levels of parasitism averaged 34% and ranged from 4 to 100% among fields. The two major species, *A. aristoteliae* and *M. argyrotaenia* accounted for over 80% of the parasitism. Other important species included *Enytus eureka*, *Phytodietus vulgaris* and *Oncophanes americanus*. The absence of any alternative host for *A. aristoteliae* in caneberry or surrounding crops such as hazelnut (*Corylus cornuta*) and the lack in synchrony of its population with suitable larval stages of *A. citrana* were probably two major factors limiting the success of this species. The codling moth eulophid parasite, *Hyssopus pallidus* was able to develop on *A. citrana* under laboratory conditions.

2. Oblique banded leafroller, *Choristoneura rosaceana*

Biology and ecology
C. rosaceana overwinters as a second- or third-instar larva in protected sites on, or near, host plants in the autumn. The larvae resume their activities in the following spring, causing bud, leaf and fruit damage. *C. rosaceana* is bivoltine in southern Quebec, Ontario, New York, Oregon, and at low altitude areas in California and British Columbia.

Females lay their eggs in masses on the upper surface of leaves (as observed on apple trees). Each female may lay 600-900 eggs. After egg laying, females secrete an oviposition-deterring pheromone.

The first-instar larvae are readily dispersed by wind (by ballooning) and require young leaves for successful establishment on the host. They feed on the undersides of leaves along the main veins and later in shelters formed by spinning together the terminal leaves, hence the common name 'leafroller'. This behaviour decreases their exposure to predators and chemical sprays.

There are typically six larval instars, although five to 10 instars have been observed in laboratory rearings. Facultative diapause may be induced by biotic and abiotic factors. A proportion of larvae enter diapause in the summer. Insects from populations exposed to insecticides are up to 70% more likely to diapause than individuals from insecticide-free populations (35%).

Pupation takes place in rolled leaves and, on emergence, adults fly from July to September. In apple orchards, most flight and mating occurs in or above the top of the tree canopy.

Oviposition preference has been determined for a limited number of hosts. Mean lifespan, fecundity and fitness varies according to diet.

Eggs
The eggs are laid in masses (200-900 eggs per mass) on the upper side of the leaves (as observed in apple trees). Egg masses are flat (i.e. a monolayer of eggs), greenish, becoming transparent and showing the head capsules of first instars.

Larvae
Overall length 16-30 mm when mature. The body is yellowish-green but large variations in colour have been observed. The head and prothoracic shield vary from black to light brown and greenish, respectively. **Early instars cannot be easily distinguished from the light brown apple moth (LBAM) and molecular diagnostics may be required to confirm identification.**

Pupae
Light greenish-brown, darkening to deep reddish-brown. Overall length, 11.4-13.5 mm.

Adults

Adult females are larger than males and are present in late June and July and in late August through September. The wingspan of adults ranges from 17 to 30 mm. The forewings are reddish-brown, with strong diagonal bands and a semicircular costal spot, which merges into a dark apical area in the female. The hindwings are greyish-white in the male and yellow and grey in the female.

C. rosaceana completes two annual generations over most of its range, only one generation is completed in northern areas of its distribution.

Distribution in US

USA	Widespread
-Arizona	Present, no further details
-Arkansas	Present, no further details
-California	Present, no further details
-Colorado	Present, no further details
-Florida	Present, no further details
-Georgia	Present, no further details
-Iowa	Present, no further details
-Louisiana	Present, no further details
-Maine	Present, no further details
-Massachusetts	Present, no further details
-Michigan	Present, no further details
-Minnesota	Present, no further details
-Mississippi	Present, no further details
-New York	Present, no further details
-North Dakota	Present, no further details
-Oregon	Present, no further

	details
-Pennsylvania	Present, no further details
-Texas	Present, no further details
-Utah	Present, no further details
-Virginia	Present, no further details
-Washington	Present, no further details
-Wisconsin	Present, no further details
-Wyoming	

Host

The larvae of *C. rosaceana* feed on the foliage or fruit of a wide variety of plants. The primary hosts are woody plants (i.e. deciduous trees) including a number of fruit trees, shrubs and conifers, with notable preference for species in the Rosaceae family.

Some of the reports of *C. rosaceana* feeding are probably casual infestations from wind-blown first-instar larvae.

Plant name

Acer rubrum	red maple
Aesculus	buckeye
Betula	birches
Betula papyrifera	paper birch
Corylus	
Corylus avellana	hazel
Crataegus	hawthorns
forest trees	woody plants
Fraxinus nigra	black ash
Ilex	Holly
Malus domestica	apple
Physocarpus	
Pistacia vera	pistachio
Platanus occidentalis	sycamore
Populus	poplars
Populus tremuloides	trembling aspen
Prunus	stone fruit
Prunus avium	sweet cherry
Prunus virginiana	common chokecherrytree
Pyrus communis	European pear

Rosa	roses
Rubus	blackberry, raspberry
Rubus idaeus	raspberry
Salix	willows
Shepherdia canadensis	Russet buffaloberry

Symptoms

The larvae of *C. rosaceana* feed in webbed terminals and rolled apple leaves. Fruit damage caused on young fruit (apple) is similar to that caused by other leafroller species. The fruit are scarred and distorted by early feeding. Damage caused by the summer larvae in August is superficial (apple) and often covers a large proportion of the epidermis.

C. rosaceana contaminates harvested raspberries when the pests are shaken off the plants by the harvesting machine. This contamination results in greater economic loss to growers than foliar damage to the crop. On cherries, the larvae bore holes in the fruit and are difficult to remove from the fruit clusters during the canning process.

The sex pheromone produced by females was first identified as a mixture, consisting mainly of (Z)-11-tetradecen-1-yl acetate (Z11-14:Ac) plus the secondary components (E)-11-tetraceden-1-yl acetate (E11-14:Ac) and (Z)-11-tetraceden-1-ol (Z11-14:OH). Western populations of C. rosaceana produce and respond to a pheromone blend containing an additional component, (Z)-11-tetradecenal (Z11-14:Ald).

Fruit: external feeding
Leaves: external feeding, leaves rolled or folded

Natural enemies

Li et al. (2001) have reviewed the biological control of *C. rosaceana*, with particular reference to Canada.

Parasitoids

A total of 14 parasitoid species (13 hymenopterans, 1 dipteran) were reared from overwintered *C. rosaceana* larvae collected from commercial raspberry fields in the Fraser Valley, British Columbia, Canada. The total parasitism of the collected *C. rosaceana* larvae ranged from 5 to 15% in managed fields, and was as high as 30% in abandoned fields. The polyembryonic *Macrocentrus nigridorsis* was the most abundant parasitoid.

The egg parasitoid *Trichogramma minutum*, originally collected from *C. rosaceana* eggs on birch trees, had a higher level of parasitism of *C. rosaceana* eggs than *T. pretiosum* or *T. sibericum*.

Trichogramma species have been researched as biological control agents in apple orchards and raspberry fields. Field trials confirmed that *T. minutum* is the most suitable of the three candidates for parasitization of *C. rosaceana* eggs on raspberries.

Predators
Little is known about the predators of *C. rosaceana*. First-, second- and third-instar larvae may be preyed upon by the coccinellids *Coccinella septempunctata* and *Harmonia axyridis*.

Pathogens
The use of *Bacillus thuringiensis* var. *kurstaki* against *C. rosaceana* has been investigated, often in raspberry fields. Several commercial formulations have been registered in the USA and Canada. A long lasting formulation has been assayed in apple orchards. *C. rosaceana* larvae were successfully controlled with a mixture of *B. thuringiensis* var. *kurstaki*.

In Quebec, Canada, a nuclear polyhedrosis virus (NPV) killed 60% of *C. rosaceana* larvae and about 10-20% of the subsequent pupae. In New Brunswick, a multiple nucleocapsid NPV (MNPV) was isolated that killed 58% of third- and fourth-instar larvae. A SNPV isolated from larvae collected in an apple orchard of Quebec killed 75% of treated larvae in laboratory assays.

The entomopathogenic nematode *Steinernema carpocapsae* may cause mortality to third-, fourth-, fifth- and sixth-instar larvae. However, a minimum of 8 h exposure is required to achieve significant mortality and the persistence of the nematodes is short in the field.

In laboratory assays, susceptibility to the microsporidium *Nosema fumiferana* varied according to the larval instar treated and the dose applied. At 2000 spores ingested by first-, fourth- and fifth-instar larvae, mortalities were 91, 24 and 5%, respectively.

Economic impact
Although *C. rosaceana* may attack several economically important crops, it was not considered a serious problem until populations of the pest became resistant to several insecticides in New York, Quebec and Ontario. For example, from 1977 to 1984, *C. rosaceana* caused from 0 to 0.13% damage to fruit at harvest in commercial apple orchards of Quebec. At the beginning of the 1990s, 25% of fruit were injured by *C. rosaceana* at harvest. There are indications that resistance has also developed in other apple-growing regions of North America. Little is known about gene flow between susceptible populations living on nearby hosts and resistant populations resident in apple orchards.

Fruit damage is more important in the northern areas where *C. rosaceana* is univoltine. *C. rosaceana* is also common in glasshouses. It is probably able to compete with native tortricids and become a pest.

Similarities to Other Species/Conditions
The tortricids *Archips podana*, *Hedya nubiferana* and *Adoxophes orana* overwinter as part-grown larvae.

Management

Cultural Control

Summer pruning and hand fruit thinning reduced fruit damage caused by *C. rosaceana* by 2-3% in large and small trees and 4-6% in only large vegetative trees, respectively.

Pheromones

Mating disruption (using dispensers loaded with synthetic pheromone) was tested in apple orchards in New York State but the level of success did not meet grower's expectations. The failure of mating disruption may be explained by the very high fecundity of females.

In Washington, sprays of thin films of kaolin-based formulations reduced female longevity, mating success and the number of eggs laid.

Plant Extracts

Plant extracts of neem (*Azadirachta indica*) and *Tanacetum vulgare* have been tested on *C. rosaceana* larvae in the laboratory. Both extracts were detrimental to the fitness and other life parameters of *C. rosaceana*.

Insecticide Resistance

Populations of *C. rosaceana* have been reported to be resistant to several insecticides in New York, Quebec and Ontario. For example, from 1977 to 1984, *C. rosaceana* caused from 0 to 0.13% damage to fruit at harvest in commercial apple orchards of Quebec. At the beginning of the 1990s, 25% of fruit were injured by *C. rosaceana* at harvest. There are indications that resistance has also developed in other apple-growing regions of North America. Little is known about gene flow between susceptible populations living on nearby hosts and resistant populations resident in apple orchards.

Possible mechanisms involved in insect resistance are: an increase in the production of detoxification enzymes, an alteration of the target enzyme or nerve cell membranes, increased excretion, and decreased cuticular penetration. Selection for resistance is correlated with negative effects on insect development, i.e. lower larval weights, reduced pupal weights and longer development times.

3. Cherry fruit worm moth, *Grapholita packardi*

Biology

The mature larva is the overwintering stage. Pupation occurs within the larval overwintering quarters during May or early June. For larvae that develop on cherries, the pupal stage lasts about 29 days. However, a pupal period of 10-14 days has been reported for larvae that develop on apple shoots. Adults emerge from mid-June to early July. Eggs are laid singly on terminal leaves of apple shoots or on fruits of other hosts, usually on sutures or rough areas, but sometimes on fruit stems. Eggs hatch in 7-10 days, and larvae bore into fruits (cherries, *Vaccinium*, *Crataegus*, rarely apples) or terminal shoots (apples).

In cherries and *Vaccinium*, larvae mature in about 3 weeks and emerge from fruits in mid-July to mid-August and begin to construct overwintering quarters. Larvae may tunnel into broken or pruned branches, lining the cavity with silk and sealing the opening, or may spin cocoons in crevices of bark or in the soil. All accounts indicate one generation annually. Habits of larvae on *Crataegus* are similar, but two generations occur on this host in New York.

Eggs

Oval, about 0.55 x 0.65 mm, initially opaque and pale-cream in colour, with embryo and head capsule of larva becoming visible before hatching.

Larva

First instar white with black head; final instar with pale-pink body, head light-brown with darker-brown pattern near stemmata, prothoracic shield pale-brown, anal shield brown, dorsal pinacula on eighth and ninth abdominal segments large, brown, and often confluent (paler and smaller in *Cydia molesta* and *C. prunivora*), anal fork present, body length 7.5-9 mm, head width 0.85-0.94 mm.

Pupa

Golden-brown, about 6 mm long, abdominal segments two to nine with one or two rows of dorsal spines, segments four to six with double row or very irregular row of spines (single, regular row in *C. molesta* and *C. prunivora*), spiracles round; in tightly woven cocoon.

Adult

Forewing length 4-5 mm, wing-span 9-11 mm, colour greyish-brown, darker in females, with broad, transverse band across middle, less distinct in females, male underside with brown spot from near base to midwing; male hindwing with large, dark-brown spot on basal half, female hindwing with basal half pale.

Distribution

G. packardi is indigenous to North America. NAPPO has reported it to be present throughout the eastern seaboard states of the USA, but specific published records in all these states have not been found. Arnett (2000) goes further, and indicates that the pest is present in all his five zones of mainland USA. The records in Canadian provinces are accepted by the Canadian NPPO. There is a doubtful record from Mexico (USDA, 1963).

USA	Restricted distribution
-California	Present, no further details
-Colorado	Present, no further details
-Delaware	Present, no further details
-Maryland	Present, no further details
-Michigan	Present, no further details
-New Jersey	Present, no further details
-New York	Present, no further details
-North Carolina	Present, no further details
-Oregon	Present, no further details
-Texas	Present, no further details
-Washington	Present, no further details
-Wisconsin	

Hosts
Except for *Vaccinium* (Ericaceae), all hosts are members of the Rosaceae.

Plant name	**Context**
Crataegus spp.	Wild host
Cydonia oblonga (quince)	Other
Malus domestica (apple)	Other
Prunus avium (sweet cherry)	Main
Prunus cerasus (sour cherry)	Main
Prunus domestica (plum)	Other
Prunus persica (peach)	Other
Prunus salicina (Japanese plum)	Other
Prunus virginiana (common chokecherrytree)	Wild host
Pyracantha (Firethorn)	Other
Pyrus communis (European pear)	Other
Rosa spp.	Other

Vaccinium corymbosum (blueberry)	Other

Growth stage
Flowering stage, Vegetative growing stage

Symptoms
In cherry, damage is normally seen on fruits, but external evidence of infestation of cherries by young larvae is occasionally not detectable. In apple, fruit damage is less common than shoot damage, which is indicated by blight of terminals and the formation of new shoots from lateral buds.

Fruit: abnormal shape; internal feeding; discoloration
Growing point: internal feeding; boring; distortion

Means of movement
The adults are dispersed over short distances by flight.

The pest has been intercepted by USDA inspectors in fruits imported from Mexico (USDA, 1963).

Plant parts liable to carry the pest in trade/transport	Pest stages	Borne
Fruits (inc. pods)	larvae	Yes No Pest or symptoms usually visible to the naked eye
Stems (above ground), Shoots, Trunks, Branches	larvae	No Yes Pest or symptoms usually visible to the naked eye

Plant parts not known to carry the pest in trade/transport

Bark	Bulbs, Tubers, Corms, Rhizomes	Flowers, Inflorescences, Cones, Calyx	Leaves
Roots	Seedlings, Micropropagated plants	True seeds (inc. grain)	Wood

Natural enemies
Parasites reported for *G. packardi* include *Chelonus grapholithae* (Braconidae), *Phanerotoma fasciata* (Braconidae), *Scambus transgressus* (Ichneumonidae), *Glypta rufiscutellaris* (Ichneumonidae), and *Psychophagus omnivorus* (Pteromalidae) and *Euderus cushmani* (Eulophidae).

Economic impact

G. packardi is primarily a pest of cherry. It was considered a major pest of this crop from 1914 to the 1960s, although it was primarily a problem in poorly sprayed orchards. In Colorado, USA, infestations of 2-3% were reported as common, and a few of 6-8% were noted.

G. packardi has been reported as an occasional pest of blueberry (*Vaccinium corymbosum*) in North Carolina, Michigan and New Jersey (USA).

G. packardi occurs infrequently on fruits and shoots of apple and other hosts. It has not been considered a significant pest of apple in USA since the early part of the twentieth century. There is only a single record on peach.

In apples, larvae penetrate the outer terminal leaves of the shoot and bore into the twig for a distance of 25-50 mm. As the twig dies, new shoots from lateral buds are penetrated. Terminal shoots of nursery stock and young orchard trees, and the tender 'water sprouts' on trunks of old trees, may be attacked. Larvae mature during late June, and moths emerge during July. A third generation results in emergence of moths in August, and the resulting larvae overwinter in silk-lined tunnels of shoots or in cocoons in crevices of bark.

Detection and inspection
Cut fruits and examine for damage

Management
Insecticide treatments for control of *Cydia pomonella* (codling moth), *Rhagoletis cingulata* (cherry fruit fly) and *R. pomonella* (apple maggot) provide incidental control of *G. packardi*.

Blueberries produced in eastern North America are at risk of contamination by two lepidopteran insects that infest developing fruit. The cranberry fruitworm (*Acrobasis vaccinii* Riley) and cherry fruitworm (*Grapholita packardii* Zeller) lay their eggs on the young green fruit beginning at petal fall (Beckwith, 1941; Hutchinson, 1954). Young larvae then penetrate the berries causing a risk of contamination to harvested fruit and also yield loss if the population is high enough (Mallampalli and Isaacs, 2002). Cherry fruitworm larvae tend to infest single berries, which often drop prematurely before harvest, thus are not a high risk as a post-harvest contaminant. Larvae of cranberry fruitworm typically infest multiple berries in a cluster, leaving frass in the silken webbing between berries. This is more apparent to inspectors than cherry fruitworm, so earlyseason insect management programs tend to focus mainly on preventing infestation by cranberry fruitworm.

Trapping protocol

Target name	**Name code for trap**	**Trap type**	**Set by date**	**Lure change interval**	**Removal**	**Hosts**	**Trap density**
Orange tortrix: ***Argyrotaenia citrana***	OTM	**Yellow** Delta or Large yellow Delta trap	June 15	4-6 weeks	After harvest	Blueberry	1 per 10 acres
Oblique banded leafroller: ***Choristoneura rosaceana***	OBL	**Yellow** Delta or Large yellow Delta trap	June 15	4-6 weeks	After harvest	Blueberry	1 per 10 acres
Cherry fruit worm moth: ***Grapholita packardi***	CFM	**Yellow** Delta or Large yellow Delta trap	June 15	4-6 weeks	After harvest	Blueberry	1 per 10 acres