Epiphyas postvittana

Figure 1. Dorsal view of *E. postvittana* adult (Natasha Wright, Florida Department of Agriculture and Consumer Services, Bugwood.org).

Scientific Name

Epiphyas postvittana (Walker, 1863)

Synonyms:

Austrotortrix postvittana, Bradley, 1956
Dichelia foedana, Walker, 1863
Dichelia retractana, Walker, 1863
Dichelia reversana, Walker, 1863
Dichelia vicariana, Walker, 1863
Pandemis consociana, Walker, 1863
Teras basialbana, Walker, 1863
Teras scitulana, Walker, 1863
Teras secretana, Walker, 1863
Tortrix oenopa, Meyrick, 1910
Tortrix pyrrhula, Meyrick, 1910
Tortrix stipularis, Meyrick, 1910
Tortrix dissipata, Meyrick, 1922
Tortrix phaeosticha, Turner, 1939

Common Name

Light brown apple moth (LBAM), apple leafroller, Australian leafroller

Type of Pest

Moth

Taxonomic Position

Class: Insecta, **Order:** Lepidoptera, **Family:** Tortricidae

Reason for Inclusion in Manual

CAPS Target: AHP Prioritized Pest List - 2003 through 2008
PPQ Program Pest

Pest Description

Figure 2. Eggs of *E. postvittana* on a leaf surface (T. M. Gilligan & M. E. Epstein, *LBAM ID*, CSU, CDFA, and USDA-APHIS-PPQ-CPHST).

Eggs: *Epiphyas postvittana* egg masses (Fig. 2) are flat, broadly oval, translucent, and appear pale yellow to white in color (Brown et al., 2010). The chorion is reticulated, which separates eggs of this species from some, but not all, tortricids in North America (Peterson, 1965). There are approximately 35 eggs in a mass, overlapping like "roof tiles or shingles." Females lay on average 100 to 300 eggs beginning at two to three days of age.

Figure 3. Early (top), mid-(middle), and late (bottom) instar larvae of *E. postvittana* (T. M. Gilligan & M. E. Epstein, *LBAM ID*, CSU, CDFA, and USDA-APHIS-PPQ-CPHST).

Larvae: From Gilligan and Epstein (2012):

"Larvae are generally yellowish green but color may vary with instar and host. Early and mid-instar larvae range from translucent to opaque reddish brown. The head of all instars is pale brown and the prothoracic shield is approximately the same color as the rest of the body. The head, prothoracic shield, and legs of mid- to late instars are not dark and do not have any dark or contrasting markings. The anal shield is pale brownish green and the anal comb is well developed with 7-9 teeth. First instar larvae are approximately 1.6 mm long, while last instar larvae are 10-20 mm in length.

Chaetotaxy is typical of most Tortricidae, with a trisetose L group on the prothorax; L1 and L2 on a common pinaculum below the spiracle on A1-7; L1 anterad of the spiracle on A8; and D2s on a common "saddle" pinaculum on A9.Typical of most Archipini, the small SD2 pinaculum is fused with the anterior edge of the large SD1 pinaculum on A1-7; D1 and SD2 are on separate pinacula on A9; the L group is trisetose with all setae on the same pinaculum on A9; the SV group on A1,2,7,8,9 is 3:3:3:2:2; V1s on A9 are nearly the same distance or only slightly further apart than those on A7 and A8. On the head capsule, AF2 and P1 are approximately the same distance apart as P1 and P2."

Figure 4. *Epiphyas postvittana* \pupa (T. M. Gilligan & M. E. Epstein, *LBAM ID*, CSU, CDFA, and USDA-APHIS-PPQ-CPHST).

Pupae: Pupae (Fig. 4) are green after pupation but become brown within one day. Male pupae average 2.5 by 7.6 mm (approx. $^{1}/_{8}$ to $^{5}/_{16}$ in); females average 2.9 by 9.8 mm (approx. $^{1}/_{8}$ to $^{3}/_{8}$ in). The pupal stage is completed within the "nests" made up of rolled up leaves (Gilligan and Epstein, 2009; Brown et al., 2010).

Adults: From Gilligan and Epstein (2012):

"Forewings of both sexes are light brown to pale yellow with brown to dark-brown markings. Males are more variable than females, although in most males the basal half of the forewing is lightly marked, the median fascia is well defined, and there is a dark mark on the costa distal to the median fascia. In California, males tend to be of three phenotypes; the form with solid dark markings on the distal half of the forewing is the most uncommon. Males have a forewing costal fold. The female forewing color is more uniform, with a poorly defined median fascia and an overall mottled or speckled appearance. Most females have a dark mark on the dorsum of each forewing and two dark spots on the posterior of the thorax. The hindwing in both males and females is mottled with dark scales, although this pattern is usually more evident in females.

Male genitalia are distinctive, and examination of these structures is essential for reliable identification. Males have a combination of the following characters: spatulate uncus; reduced socii; short valva with a broad sacculus; membranous lobe on the apex of the valve (the most diagnostic feature); and an aedeagus with 2-4 deciduous cornuti. Female genitalia are typical of many Archipini and females may be difficult to verify based on dissection alone. Females possess a combination of the following characters: simple sterigma; long, straight ductus bursae which is $^{2}/_{3}$ or more the length of the abdomen; and corpus bursae with a single, hook-shaped signum."

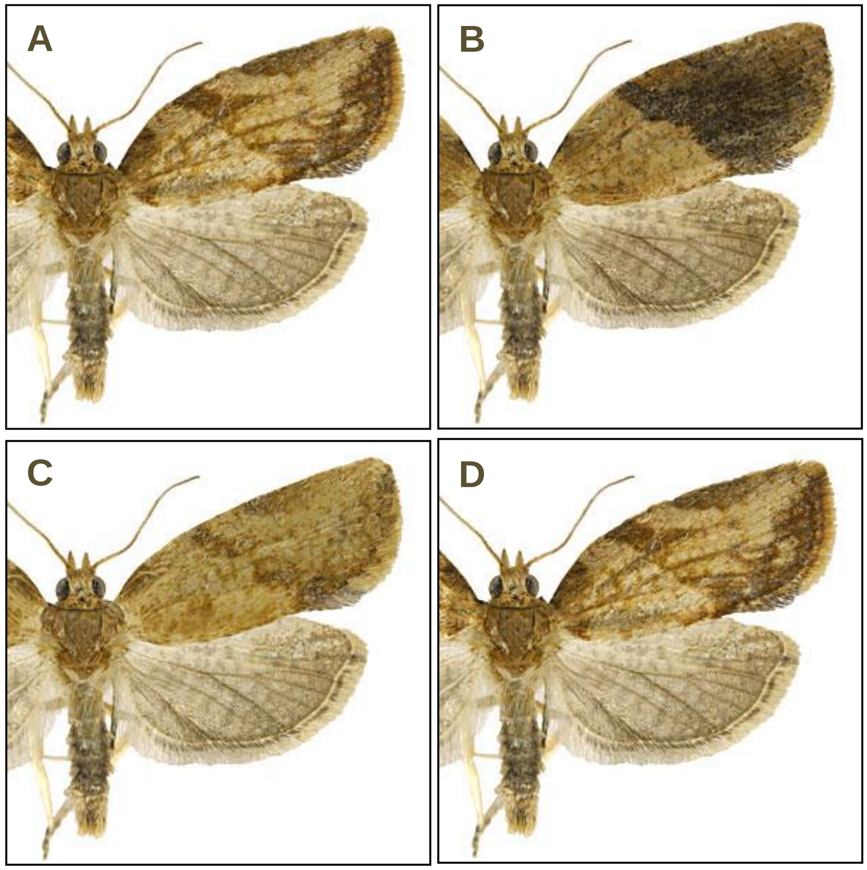

Figure 5. A. Typically marked male. **B.** Male with dark wings. **C.** Male with light wings. **D.** Typically marked female (T. M. Gilligan & M. E. Epstein, *LBAM ID*, CSU, CDFA, and USDA-APHIS-PPQ-CPHST).

Female genitalia (Fig. 6) are typical of many Archipini and females may be difficult to verify based on dissection alone. *Epiphyas postvittana* females possess a combination of the following characters: simple sterigma; long, straight ductus bursae which is two-thirds or more the length of the abdomen; and corpus bursae with a single, hook-shaped signum (Gilligan and Epstein, 2009).

"Adults are similar to other species of *Epiphyas* as well as many Nearctic Archipini. A dissection can be used to confirm identity. Male *E. postvittana* have a large membranous lobe on the apex of the valva that is not present in most Nearctic tortricids. A membranous lobe is present in many *Clepsis* (*C. fucana*, *C. peritana*, and *C.*

virescana), but the lobe in *E. postvittana* is much larger and forms a conspicuous notch that is not present in species like *C. peritana" (Gilligan and Epstein, 2012).*

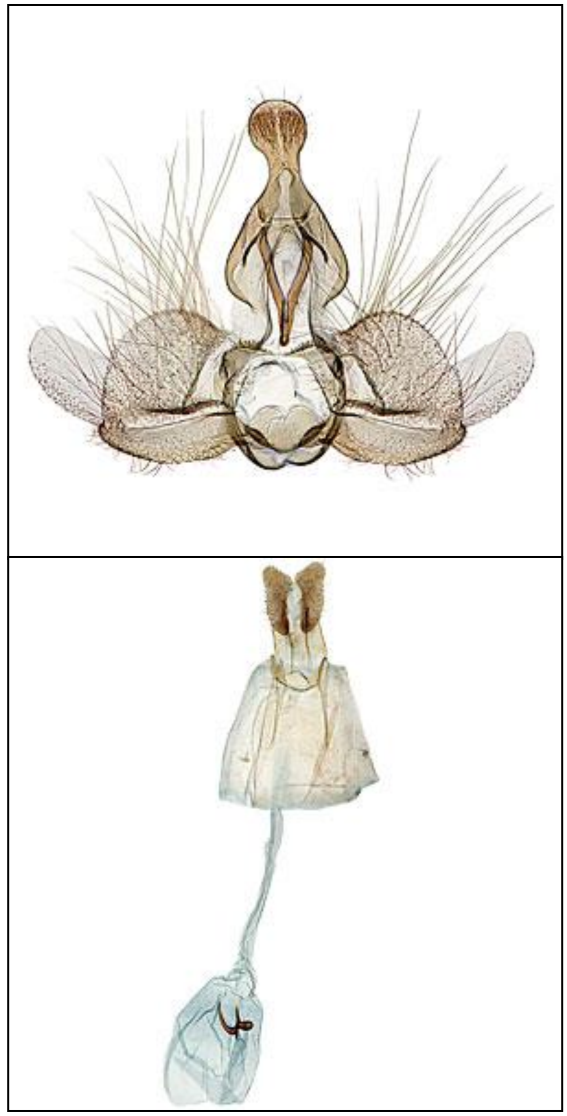

Figure 6. Top: Male genitalia. **Bottom:** Female genitalia (T. M. Gilligan & M. E. Epstein, *LBAM ID*, CSU, CDFA, and USDA-APHIS-PPQ-CPHST).

Biology and Ecology

Epiphyas postvittana has two to four annual generations over much of its range; the exact number of generations varies by latitude. There is considerable overlap between generations, with development driven by temperature and larval host plant (Danthanarayana, 1975; Geier and Briese, 1980; Thomas, 1989). The highest rate of population increase was on *Plantago lanceolata* (ribwort plantain), followed by *Rumex crispus* (curly dock), *Malus domestica* cv. Granny Smith (apple), and *Trifolium repens* (white clover) (Danthanarayana et al., 1995). In northern New Zealand, four overlapping generations occur, with adults flying during September to October, December to January, February to March, and April to May. In southern Australia, three overlapping generations are completed, with adults flying during December to January, April to May, and September to October. Populations in California appear to complete at least four overlapping generations, with adults present almost continuously from March to November. The upper and lower temperature thresholds for *E. postvittana* development have been determined to be 7.5°C (46°F) and 31°C (88°F) in laboratory studies, with an ideal development temperature of 20°C (68°F) (Danthanarayana, 1975; Brown et al., 2010).

Females lay eggs in a mass that contains from 4 to 96 (mean 35) overlapping eggs (Wearing et al., 1991). Females deposit eggs at night (USDA, 1984). Eggs are laid on the upper surface of host plants with smooth leaf surfaces; females will refrain from depositing eggs on hairy leaves (Danthanarayana, 1975; Geier and Briese, 1981; Foster and Howard, 1998). Females often select the depression along the upper side midrib of leaves (Powell and Common, 1985). Egg development time varies with temperature and eggs will hatch in approximately eight to nine days at 20°C (68°F) (Gilligan and Epstein, 2009).

Larvae pass through five to six instars during their development. Larvae do not overwinter, although development during colder months is slower. The rate of development varies with temperature and host plant utilized; larval development takes approximately 25 days at a temperature of 20°C (68°F). Early instar larvae feed on the underside of leaves within a silk chamber. Later instar larvae may fold single leaves, create a nest of several leaves webbed together, or web leaves to fruit and feed on the surface.

Pupation occurs within the larval nest. Complete pupal development takes approximately 10 days at a temperature of 20°C (68°F) (Danthanarayana, 1975). Adult moths emerge after one to several weeks of pupation. Female moths emerge from protective pupal nests and mate soon after emergence (Geier and Briese, 1981). Danthanarayana (1975) suggests the preoviposition period lasts 2 to 7 days. Females copulate for slightly less than one hour (Foster et al., 1995). Oviposition does not begin until females are two to three days old (Geier and Briese, 1981). The oviposition period lasts from one to 21 days (Danthanarayana, 1975). Adult longevity is influenced by host plant and temperature. In the laboratory, female longevity can vary between 10 (Geier and Briese, 1981) and 32.7 days (Danthanarayana, 1975); males can live up to approximately 33 days (Danthanarayana, 1975). Under field conditions in Australia, the life span of adult *E. postvittana* is 2 to 3 weeks (Magarey et al., 1994).

Moths are quiescent during the day and may be found on foliage of hosts (Geier and Briese, 1981). Adults are able to disperse long distances (Geier and Briese, 1980; Suckling et al., 1994), although larval dispersal occurs over a short range. Flight occurs at dusk in calm conditions (Geier and Briese, 1981; USDA, 1984; Magarey et al., 1994). Adults are unlikely to disperse from areas with abundant, high-quality hosts (Geier and Briese, 1981). Males will disperse farther than females. In a mark-release-recapture study, 80% of recaptured males and 99% of recaptured females occurred within 100 m (328 ft) of the release point (Suckling et al., 1994). Females do not appear to rely on plant volatiles to locate hosts, but tactile cues are important (Foster and Howard, 1998). Humidity influences the dispersal ability of the pest (Danthanarayana et al., 1995).

Although they are sheltered in silk, first instar larvae are more exposed to weather and insecticide treatments than are second and third instar larvae (Madge and Stirrat, 1991; Lo et al., 2000). After approximately three weeks, larvae leave the silken tunnels for a new leaf (USDA, 1984). Second and later instars have the ability to create their own protective feeding shelter by rolling a leaf or webbing multiple leaves together (Danthanarayana, 1975; Lo et al., 2000); these behaviors are characteristic of the family Tortricidae.

Figure 7. Typical *Epiphyas postvittana* damage to host plant foliage (T. M. Gilligan & M. E. Epstein, *LBAM ID*, CSU, CDFA, and USDA-APHIS-PPQ-CPHST).

Larvae move vigorously when disturbed but are always connected to the leaf by a silken thread to avoid being removed from the leaf (Nuttal, 1983; USDA, 1984). When larvae happen to fall to the ground, they feed on ground-cover hosts or can survive without feeding for several months (Evans, 1937; Thomas, 1975; USDA, 1984).

Epiphyas postvittana is more abundant during the second generation than during other generations (MacLellan, 1973; Madge and Stirrat, 1991). Thus, the second generation causes the most economic damage (Evans, 1937; Thomas, 1975; Madge and Stirrat, 1991; Lo et al., 2000) as larvae move from foliage to fruit (MacLellan, 1973; Magarey et al., 1994).

Damage

Epiphyas postvittana feeds on foliage (Fig. 7), flowers, and fruit. In spring, the pest feeds on new buds while later generations feed on ripened fruits (Buchanan et al., 1991). After the first molt, they construct typical leaf rolls (nests) by webbing together leaves, a bud and one or more leaves, leaves to a fruit, or by folding and webbing individual mature leaves. During the fruiting season, they also make nests among clusters of fruits, damaging the surface and sometimes tunneling into the fruits (Danthanarayana, 1975).

Fruit surface feeding is common within larval nest sites and is typically caused by later instars (Lo et al., 2000). Clusters of fruit are particularly susceptible. On a fruit, the calyx offers protection from parasitoids and is probably the best feeding location for young larvae (Lo et al., 2000). Larvae entering the fruit through the calyx may cause internal damage. Feeding on the foliage by larvae causes ragging and curling of the foliage.

Citrus: Larval feeding can cause "fruit drop or halo scars around the stem end of fruit" (Johnson et al., 2007).

Conifer: Damage occurs through larval activity "such as needle tying, chewing of buds, and boring into stems. In tree nurseries, damage to terminal buds on seedlings and saplings can cause multiple or crooked leaders" (Johnson et al., 2007).

Grape: Leafrollers, including LBAM, damage grape bunches through larval feeding on the flowers, berries and stalks Lo and Murrell, 2000). Extensive loss of flowers or newly set berries can occur in the spring (Johnson et al., 2007). Berries can also be damaged by becoming infected with fungi, like *Botrytis cinerea* (Lo and Murrell, 2000).

Pome fruit: Damage to apples is in the form of either pinpricks, which are flask-shaped holes about 3 mm (approx. $^{1}/_{8}$ in) deep into the fruit, or entries, which are holes extending deeper than 3 mm into the fruit that leaves some frass and webbing at the surface. On apples, skin damage or blemishes have an irregular cork-like appearance. Larvae may excavate small round pits and produce scars similar to the 'stings' of the larvae of *Cydia pomonella*, the codling moth. The first generation (in spring) causes the most damage to apples; while the second generation damages fruit harvested later in the season (Terauds, 1977).

Stone fruit: Peaches are damaged by feeding that occurs on the shoots and fruit.

Pest Importance

The larva of *E. postvittana* is a serious pest of fruit and ornamentals in Australia and New Zealand. As a pest of pome fruits, particularly apples, it probably ranks second to *Cydia pomonella*, the codling moth. During a severe outbreak, damage by *E. postvittana* to fruit may be as much as 75%. In Tasmania, this species is the most injurious pest of apples. In years of abundance, populations of the light brown apple moth may cause as much as 25% loss of the apple crop. This pest damages fruit in storage; a few larvae may ruin a whole case of fruit. The markings on the fruit render it unfit for export (USDA, 1984).

Epiphyas postvittana is a highly polyphagous pest that attacks a wide number of fruits, ornamentals, and other plants. According to Geier and Briese (1981), "Economic damage results from feeding by caterpillars, which may destroy, stunt or deform young seedlings, spoil the appearance of ornamental plants, and/or injure deciduous fruit-tree crops, citrus, and grapes." Losses in Australia were estimated to be AU$21million (~U.S. $22.15 million) per year, but there has been no similar estimation in other countries.

The larvae can be very damaging to grape, apple, and peach. In grape, 70,000 larvae/ha were documented to cause a loss of 4.7 tons of chardonnay fruit in 1992 with an estimated cost of $2,000/ha (Bailey et al., 1995). A single larva can destroy about 30 grams of mature grapes.

Mature larvae are the most difficult stage to control. *Epiphyas postvittana* is also difficult to control with sprays because of its leaf-rolling ability; there is also evidence of resistance due to overuse of sprays (Geier and Briese, 1981).

Known Hosts

Epiphyas postvittana is a polyphagous pest and can damage nursery stock, stone fruit (peaches and apricots), pome fruits (apples and pears), grapes, and citrus. This pest can feed on over 500 plant species in 121 families and 363 genera giving it the potential to become extremely destructive (Brown et al., 2010; Suckling and Brockerhoff, 2010). Larvae prefer herbaceous plants over woody ones (Brown et al., 2010).

Major hosts
Acca sellowiana (feijoa fruit), *Actinidia* spp. (kiwi/Chinese gooseberry), *Chrysanthemum* spp. (chrysanthemum), *Citrus* spp. (citrus), *Cotoneaster* spp., *Crataegus* spp. (hawthorns), *Diospyros* spp. (malabar ebony), *Diospyros kaki* (Japanese persimmon), *Eucalyptus* spp. (eucalyptus), *Humulus lupulus* (hops), *Jasminum* spp. (jasmine), *Ligustrum vulgare* (privet), *Litchi chinensis* (lychee), *Malus* spp. (apple), *Medicago sativa* (alfalfa), *Persea americana* (avocado), *Pinus* spp. (pines), *Pinus radiata* (radiata pine), *Populus* spp. (poplars), *Prunus armeniaca* (apricot), *Prunus persica* (peach), *Pyrus* spp. (pears), *Ribes* spp. (currants), *Rosa* spp. (roses), *Rubus* spp. (blackberry, raspberry), *Solanum* spp. (potato/tomato), *Trifolium* spp. (clovers), *Vaccinium* spp. (blueberries), *Vicia faba* (broad bean), and *Vitis vinifera* (grapevine) (CABI, 2012).

Other hosts
Acacia spp. (wattles), *Adiantum* spp. (maidenhead fern), *Alnus glutinosa* (black alder), *Amaranthus* spp. (amaranth), *Aquilegia* spp. (columbine), *Arbutus* spp. (madrone), *Arctotheca calendula* (capeweed), *Artemisia* spp. (sagebrush), *Astartea* spp. (astartea), *Aster* spp. (aster), *Baccharis* spp. (baccharis), *Billardiera* spp. (billadriera), *Boronia* spp. (baronia), *Brassica* spp. (mustards), *Breynia* spp. (breynia), *Bursaria* spp. (bursaria), *Buddleja* spp. (butterfly bush), *Calendula* spp. (marigold), *Callistemon* spp. (bottlebrush), *Camellia japonica* (camellia), *Campsis* spp. (trumpet-vine), *Cassia* spp. (senna), *Ceanothus* spp. (red-root/lilac), *Centranthus* spp. (fox-brush), *Chenopodium album* (lambsquarters/fat-hen), *Choisya* spp. (choisya), *Clematis* spp. (virgin's-bower), *Clerodendron* spp. (glory-bower), *Correa* spp. (correa), *Crocosmia* spp. (montbretia), *Cupressus* spp. (cypress), *Cydonia* spp. (quince), *Cytisus scoparius* (Scotch broom), *Dahlia* spp. (dahlia), *Datura* spp. (thorn-apple), *Daucus* spp. (carrot), *Dodonaea* spp. (dodonea), *Erigeron* spp. (fleabane), *Eriobotrya* spp. (loquat), *Eriostemon* spp. (eristemon), *Escallonia* spp. (escallonia), *Euonymus* spp. (euonymus), *Forsythia* spp. (forsythia), *Fortunella* spp. (kumquat), *Fragaria* spp. (strawberry), *Gelsemium* spp. (jasmine), *Genista* spp. (broom), Gerbera spp. (daisy), *Grevillea* spp. (spider-flower), *Hardenbergia* spp. (hardenbergia), *Hebe* spp. (hebe/speedwell), *Hedera* spp. (ivy), *Helichrysum* spp. (everlasting), *Hypericum perforatum* (St. John's wort), *Juglans* spp. (walnut), *Lathyrus* spp. (sweet pea), *Lavandula* spp. (lavender), *Leucadendron* spp. (leucodendron), *Leptospermum* spp. (manuka), *Lonicera* spp. (honeysuckle), *Lupinus* spp. (lupine), *Macadamia integrifolia* (macadamia), *Mangifera indica* (mango), *Melaleuca* spp. (bootlebrush), *Mentha* spp. (mint), *Mesembryanthemum* spp. (ice-plant),

Michelia spp. (banana-shrub), *Monotoca* spp. (monotoca), *Myoporum* spp. (sandle-wood), *Oxalis* spp. (wood-sorrel), *Parthenocissus* spp. (ivy), *Pelargonium* spp. (geranium), *Persoonia* spp. (persoonia), *Petroselinum* spp. (parsley), *Philadelphus* spp. (mock-orange), *Photinia* spp. (photinia), *Phyllanthus* spp. (phyllanthus), *Pittosporum* spp. (pittosporum), *Plantago lanceolata* (plaintain/ribwort), *Platysace* spp. (platysace), *Polygala* spp. (milkwort), *Polygonum* spp. (knotweed), *Pteris* spp. (brake-fern), *Pulcaria* spp. (fleabane), *Pyracantha* spp. (fire-thorn), *Quercus* spp. (oak), *Ranunculus* spp. (buttercup), *Raphanus* spp. (radish), *Reseda* spp. (coneflower), *Rumex* spp. (dock), *Salix* spp. (willow), *Salvia* spp. (sage), *Senecio* spp. (ragwort), *Sida* spp. (side), *Sisymbrium* spp. (mustard), *Smilax* spp. (cat-brier), *Tithonia* spp. (sunflower), *Trema* spp. (trema), *Triglochin* spp. (arrow grass), *Ulex europaeus* (gorse), *Urtica* spp. (nettle), *Viburnum* spp. (arrow-wood), and *Vinca* spp. (periwinkle) (Danthanarayana, 1975; Wearing et al., 1991; Venette et al., 2003; Brown et al., 2010; reviewed in Gilligan and Epstein, 2012).

Pathogens or Associated Organisms Vectored

An association between larvae of *E. postvitanna* and *Botrytis cinerea* (Fig. 8), gray mold, has been shown in grapes. *Epiphyas postvittana* has been shown to introduce *Botrytis cinerea* spores into wounds via contaminated larvae, with up to 13% of berry damage (by weight) as a result (Bailey, 1997). Wet conditions may also allow the entry of rot organisms.

Figure 8. Discolored, shriveled berries caused by *Botrytis* bunch rot (left) and *Botrytis cinerea* sporulating on grape berries (P. Sholberg, Agriculture & AgriFood Canada).

Known Distribution

Epiphyas postvittana is indigenous to Australia. *Epiphyas postvittana* is widespread throughout Australia and New Zealand on many weedy hosts including gorse (*Ulex* *europaeus*) and broom (*Cytisus scoparius*). It is commonly present in gardens and unsprayed horticultural crops.

Europe: Azores (Portugal), Ireland, Netherlands, Sweden, United Kingdom; **North America:** United States (California); **Oceania:** Australia and New Zealand (Meyrick, 1937; Bradley, 1973; Wolschrijn and Kuclein, 2006; Svensson, 2009; Hummer et al., 2009; Suckling and Brockerhoff, 2010).

Although it was reported from New Caledonia, its presence in that country could not be verified by Suckling and Brockerhoff (2010).

This species has also been listed as occurring in South Africa (Smith et al., 2007), but I found no evidence that this is the case.

Pathway

The immature life stages of this species can be readily transported on plant material; this could include plant parts and growing medium accompanying plants. This species has been introduced into other countries on apples (*Malus domestica*) and other plant material (CABI, 2012).

This species has historically been intercepted at U.S. ports of entry. No interceptions have been recorded since 2009 (AQAS, 2014, queried June 6, 2014). Interceptions occurred on a variety of host material, including *Vaccinium* spp., *Prunus* spp., *Malus* spp., and *Fragaria* spp. All interceptions occurred on material originating from New Zealand and Australia (AQAS, 2014, queried June 6, 2014).

This species is currently found in California and natural spread to other areas of the United States may occur.

Potential Distribution within the United States

Epiphyas postvittana has been reported to occur in Hawaii since 1896 (Zimmerman, 1978). On March 16, 2007, *E. postvittana* was confirmed in Alameda County, California. As of March 2012, further detections have occurred in Alameda, Contra Costa, Fresno, Los Angeles, Madera, Marin, Monterey, Napa, Sacramento, San Benito, San Diego, San Francisco, San Joaquin, San Luis Obispo, San Manteo, Santa Barbara, Santa Clara, Santa Cruz, Solano, Sonoma, Ventura, and Yolo Counties. A single moth of *E. postvittana* was detected in the summer of 2010 in Oregon. To date, despite extensive trapping, no additional moths have been trapped indicating that the moth is not established in Oregon.

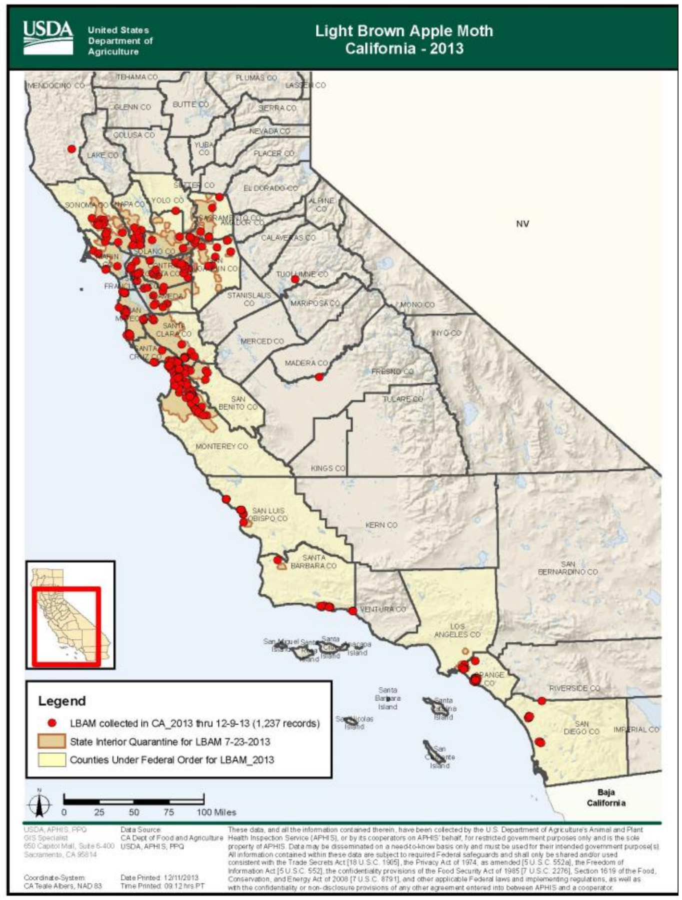

Figure 9. Quarantine and distribution map for *Epiphyas postvittana* in California. Updated December 2013.

Information on the current status of LBAM in the United States can be found here: http://www.aphis.usda.gov/wps/portal/aphis/ourfocus/importexport?1dmy&urile=wcm%3apath%3a%2Faphis_content_library%2Fsa_our_focus%2Fsa_plant_health%2Fsa_domestic_pests_and_diseases%2Fsa_pests_and_diseases%2Fsa_insects%2Fsa_lba_moth%2Fct_lbam_home.

Survey

CAPS-Approved Method*:

The CAPS approved method is a trap and lure combination. There are two approved traps: the Jackson trap and the large plastic delta trap. However, the Jackson trap is the preferred trap. The lure is effective for 42 days (6 weeks).

In order to standardize data reporting and trap procurement for the LBAM Program, it is preferable that states use the Jackson trap.

Trap color is up to the state and does not affect trap efficacy.

IPHIS Survey Supply Ordering System Product Names:

1) Jackson Trap Body
2) Large Plastic Delta Trap Kits, Orange
3) Large Plastic Delta Trap Kits, Red
4) Large Plastic Delta Trap Kits, White
5) *Epiphyas postvittana* Lure

IMPORTANT: Do not include lures for other target species in the trap when trapping for this target.

Trap spacing: When trapping for more than one species of moth, separate traps for different moth species by at least 20 meters (65 feet).

Trap placement:
In previous studies, traps have been placed between 1.5 to 2 m (5 to 6.5 feet) above ground level (reviewed in Venette et al., 2003). In California, when traps are placed in fruit trees, traps are placed in the upper $^{1}/_{3}$ to $^{1}/_{2}$ of the tree canopy and $^{1}/_{3}$ to $^{2}/_{3}$ of the distance from the tree trunk to the outer edge of the foliage (Anonymous, 2013).

Survey Site Selection:
Surveys should be focused on areas where host material is present. Due to the wide host range, this species may be found in natural areas, urban settings, and agricultural crops. Surveys may occur include nurseries, orchards, and vineyards. Surveys should be focused on areas with preferred hosts. See the 'Known Hosts' section for more information.

Time of year to survey:
Populations in California appear to complete at least four overlapping generations, with adults present almost continuously from March to November. Surveys can begin in spring or summer. The national survey begins in July and runs for a period of five months.

More information on trapping LBAM in the United States can be found on the PPQ LBAM Program website.

*For the most up-to-date methods for survey and identification, see Approved Methods on the CAPS Resource and Collaboration Site, at https://caps.ceris.purdue.edu/node/223.

Literature-Based Methods: (Taken from Venette et al., 2003 and CABI, 2009)
Trapping: Pheromone traps have been widely used for detection and monitoring of populations of this species (Bellas et al., 1983). Two key components of the pheromone are (E)-11-tetradecenyl acetate and (E,E)-(9,11) tetradecadienyl acetate (Bellas et al., 1983). These compounds in a ratio of 20:1 are highly attractive to males. This lure is typically formulated on a rubber septum (1 to 3 mg).

Foster and Muggleston (1993) provide a detailed analysis of different designs of delta traps. In general, they found that traps with a greater length (i.e., the distance between the two openings of the trap) capture significantly more *E. postvittana* than shorter traps. This effect is not related to saturation of smaller sticky surfaces with insects or other debris. The addition of barriers to slow the exit of an insect from a trap also improves catch. In a separate analysis, Foster et al. (1991) found that placing the pheromone lure on the side of the trap helped to improve trap efficiency. The orientation of the trap relative to wind direction did not affect the number of *E. postvittana* that were attracted to the pheromone or were subsequently caught by the trap (Foster et al., 1991).

Visual survey: Visual inspections have been used to monitor population dynamics of *E. postvittana* eggs and larvae. In grape, 40 vines were inspected per sampling date (Buchanan, 1977). In apple and other tree fruits, 200 shoots and 200 fruit clusters (10 of each on 20 different trees) are often inspected (Bradley et al., 1998). Larvae are most likely to be found near the calyx or in the endocarp; larvae may also create "irregular brown areas, round pits, or scars" on the surface of a fruit (USDA, 1984). Larvae may also be found inside furled leaves, and adults may occasionally be found on the lower leaf surface (USDA, 1984). However, for early detection surveys such as the CAPS program, pheromone traps are the preferred survey method.

Not recommended: Adults are also attracted to fruit fermentation products as a 10% wine solution has been used as an attractant and killing agent for adults (Buchanan, 1977; Glenn and Hoffmann, 1997). The dilute wine (670 ml) in 1 liter jars was hung from grapevines on the edge of a block of grapes (Buchanan, 1977). Black light traps have been used to monitor adults of *E. postvittana* (Thwaite, 1976).

Key Diagnostics/Identification

CAPS-Approved Method*:
Confirmation of *E. postvittana* is by morphological identification. Many native tortricids could be confused with *E. postvittana*. Identification requires dissection of male genitalia.

Specimens can be sorted and screened based on the level of available expertise. Level 1 screening is difficult for small moths and may need to be performed by a trained

Lepidopterist. When in doubt distinguishing first level screening characters, forward traps that have passed the sorting requirements to a trained taxonomist. Use Gilligan et al. (2014) for both sorting and screening.

Gilligan, T. M., M. E. Epstein, S. C. Passoa, and J. Brambila. 2014. Screening aid: Light brown apple moth, Epiphyas postvittana (Walker). https://caps.ceris.purdue.edu/dmm/2565

A new identification tool, *Tort AI – Tortricids of Agricultural Importance*, is available at http://idtools.org/id/leps/tortai/ from CPHST's Identification Technology Program. This tool contains larval and adult keys, fact sheets, an image gallery, molecular search capacity, and more. *Epiphyas postvittana* is included in this tool.

LBAM ID: Tools for Diagnosing Light Brown Apple Moth and Related Western U.S. Leafrollers (Tortricidae: Archipini) can be found online at: http://keys.lucidcentral.org/keys/v3/LBAM/

A webinar on LBAM Adult Screening from July 1, 2008, with Marc Epstein (CDFA Biosystematist) can be found here: http://www.aphis.usda.gov/plant_health/plant_pest_info/lba_moth/downloads/screening aid-video.wmv.

More information on identifying LBAM in the United States can be found on the PPQ Program website.

*For the most up-to-date methods for survey and identification, see Approved Methods on the CAPS Resource and Collaboration Site, at https://caps.ceris.purdue.edu/node/223.

Easily Confused Species

From Gilligan et al (2014):

"The wing pattern of *E. postvittana* is quite variable and adults appear similar to many species of tortricids in other genera such as *Choristoneura, Argyrotaenia, Clepsis,* and *Pandemis.* A genitalic dissection is usually necessary to confirm the identity of *E. postvittana* adults."

For images of similar species, see:

Gilligan, T. M., M. E. Epstein, S. C. Passoa, and J. Brambila. 2014. Screening aid: Light brown apple moth, Epiphyas postvittana (Walker). https://caps.ceris.purdue.edu/dmm/2565

Commonly Encountered Non-targets

The most commonly encountered non-target in Florida is the tortricid *Platynota exasperatana* (Brambila, 2012). Other species captured during Florida surveys are

Acrolophus mycetophagus, Acrolophus piger, Clepsis peritana, *Garella nilotica*, and *Platynota nigrocervina* (Brambila, 2012).

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Revisions

September 2014

1) Added **Figure 1.** Dorsal view of *E. postvittana* adult.
2) Revised the **Damage** section.
3) Revised the **Known Distribution** section.
4) Revised the **Pathway** section.
5) Revised the **Potential Distribution within the United States** section.
6) Added **Figure 9.** Quarantine and distribution map for *Epiphyas postvittana* in California.
7) Revised **Survey** section.
8) Revised the **Key Diagnostics/Identification** section.

November 2014

1) Revised the **Synonyms** section
2) Revised the **Pest Description** section.