UC IPM Online -
University of California Statewide Integrated Pest Management Program

European Grapevine Moth, *Lobesia botrana*: A New Pest in California

Grape pest management guidelines


Adult female European grapevine moth.

Lobesia botrana, European grapevine moth was first reported in the United States from Napa County vineyards in October 2009. Native to Southern Italy, it was first described from Austria and is now found throughout Europe, North and West Africa, the Middle East, and eastern Russia. It was more recently introduced into Japan, and in 2008, it was first reported in Chile. It belongs to the family Tortricidae, sub-family Olethreutinae. Earlier species names included *Polychrosis botrana* and *Eudemis botrana*. In Europe, some of the common names are *eudemis* (France); *tignolleta della vite* (Italy); *bekreuzter traubenwickle* (Germany); *polilla del racimo* (Spain); and European grape berry moth and European vine moth (English-language literature).


Feeding by larvae of European grapevine moth results in contamination of bunches with webbing, frass, and fungal infections.

Grape (*Vitis vinifera*) and spurge laurel (*Daphne gnidium*) are preferred hosts, but it has also been reported on blackberry (*Rubus fruticosus*), gooseberry (*Ribes* sp.), black and red currant (*Ribes nigurm*), olive (*Olea europea*), cherry (*Prunus avium*), prune (*Prunus domestica*), persimmon (*Diospyrus kakis*), kiwi (*Actinidia chinensis*), pomegranate (*Punica granatum*), carnation (*Dianthus* spp.), and a number of other wild hosts.

Another species of grape berry moth, *Endopiza viteana*, is found east of the Rocky Mountains. This species is native to the eastern United States and causes damage very similar to that of *L. botrana*, but the two species should not be confused. They differ in many ways, including life cycle, host range, pheromone composition, and natural enemies (the Hymenoptera parasitoids in particular). In other regions of the world, including Europe, numerous species are commonly referred to as berry and vine moths, thus it is important to verify the scientific name *Lobesia botrana* when searching the literature for information on this pest.

Damage


Grapevine moth larvae hollow out berries, leaving behind the skin and seeds.

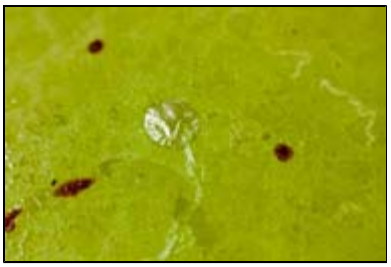
In May and June, first-generation larvae web and feed on the flower clusters. Second-generation larvae (July-August) feed on green berries. Young larvae penetrate the berry and hollow them out, leaving the skin and seeds. Third-generation larvae (August-September) cause the greatest damage by webbing and feeding inside berries and within bunches, which become contaminated with frass (excrement). Additionally, feeding damage to berries after veraison exposes them to infection by *Botrytis* and other secondary fungi such as *Aspergillus*, *Alternaria*, *Rhizopus*, *Cladosporium*, and *Penicillium*. Secondary pests such as raisin moth (*Cadra figulilella*), fruit flies, and ants may also be attracted to damaged berries.

Identification

The adult moth is approximately 0.24 to 0.3 inch (6-8 mm) long, with a wingspan of 0.4 to 0.5 inch (11-13 mm), with the female being slightly larger. Both males and females have similar mosaic-patterned wings. The first pair of wings (forewings) is tan-cream in color, mottled with gray-blue, brown, and black blotches. The second pair of wings is gray with a fringed border. The wings are held in a bell shape over the abdomen when at rest.

Unlike other common vineyard tortricids, which lay eggs in overlapping masses, eggs of *L. botrana* are laid singly. The eggs are elliptical and flat, approximately 0.025 to 0.03 inches (0.6-0.8 mm) in diameter. These lentil-shaped eggs are visible to the naked eye. Initially they are

iridescent creamy white, turning yellow as the embryo develops and later black when the head of the developing larva is formed. The larva emerges from the edge of the egg and leaves the translucent, iridescent chorion (outer shell) attached.



The shell (chorion) of a European grapevine moth egg, from which the larva has emerged, on the surface of a grape berry.

The larvae are similar to other tortricids. There are 5 immature stages (instars) with sizes ranging from 0.04 inch (1 mm) at emergence to approximately 0.5 to 0.6 inch (12-15 mm) when fully grown. Upon emergence the larva is creamy white with a black head. As it develops the head and pro-thoracic shield (first segment behind the head) is tan to yellowish brown in color. The rear edge (closest to the body) of the pro-thoracic shield has a darker brown to black border. In early stages the body is tan to yellow-brown. In later larval stages, the cuticle is transparent, such that the body takes on the color of its gut contents (from dark green to shades of dark pink and maroon). White tubercules at the base of the body hairs are quite visible on mature larvae. The thoracic legs are dark brown to black. The anal comb, a toothed structure on the last abdominal segment, has 5 to 6 dark brown teeth.

Exit hole in a parasitized European grapevine moth egg.

Fifth instar larvae spin a grayish-white silken cocoon in which they pupate. The male pupa is approximately 0.16 to 0.28 inch (4-7 mm) long and the female is 0.2 to 0.35 inch (5-9 mm) long.

Larvae of European grapevine moth have dark legs and a dark marking on the outside, rear edge of the prothoracic shield.

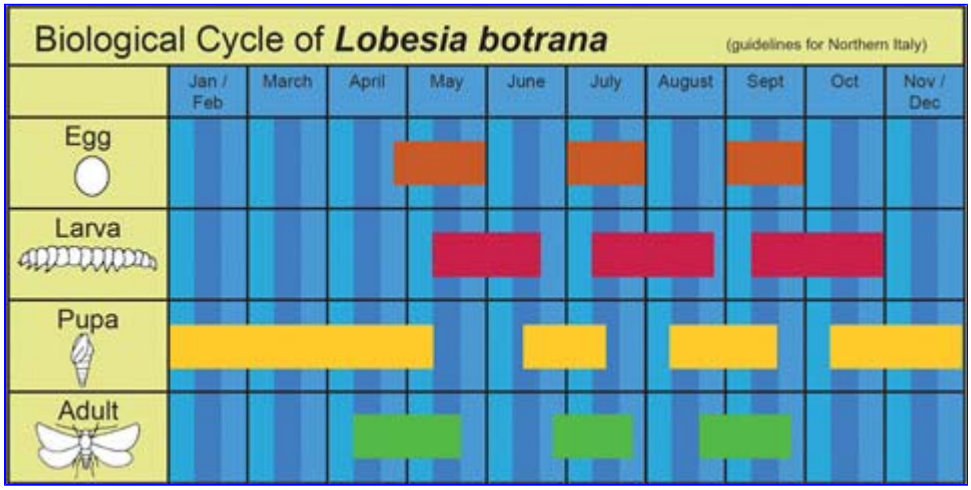
Seasonal life cycles

European grapevine moth has two generations in northern Europe, three generations in southern Europe and it is reported to have a partial fourth generation in warmer regions of Spain, Greece, Jordan, and Egypt. The first-generation population tends to be the largest, although it is not the most damaging. Pupae overwinter in diapause (a resting state) inside silken cocoons found under the bark on the underside of cordons and arms, in soil cracks, or in hidden places on trellis posts. Adults of the first generation emerge when air temperatures exceed a threshold of 50°F (10°C) for a period of 10 to 12 days. Adult males emerge about a week before females. The first male flight may begin as early as bud break and continue for 4 to 5 weeks. Adults remain hidden during the day, emerging to fly at dusk if temperatures are above 53.6°F (12ºC). Mating occurs in flight. The majority of females mate only once although they are capable of mating multiple times. Egg laying begins one or two days after mating. Eggs of the first generation are glued singly on flat surfaces on or near the flower cluster (e.g., on the bunch peduncle or on the flower calyptra). A female can lay as many as 35 eggs a day for about 6 days, with a mean of 80 to 140 eggs laid per female, depending on the generation. Adult lifespan is from 1 to 3 weeks depending on climatic conditions.

Egg hatch depends on temperature, and ranges from 3 to 5 days under optimal conditions in summer to 10 to 11 days in spring when conditions are less favorable. The first generation larvae web flower parts together and feed on individual flowers and pedicels; they may enter the peduncle and cause the bunch to dry up. Like other tortricid larvae, when disturbed they will wiggle and drop on a silken thread. Larval development is completed in 20 to 30 days depending on temperature. Pupation occurs inside a webbed cocoon that may be found on the flower cluster, under the bark on cordons, or in soil cracks. Adults emerge 6 to 14 days after pupation. The adult and egg stages are considered the most vulnerable to environmental factors.

Earlier stages of European grapevine moth larvae are tan to yellow-brown

(top). Later stages become dark colored (bottom).



This life cycle is for Northern Italy which is at approximately 42 to 44° North Latitude, while Napa is at 38°N.
Illustration credit: Zangheri S, Briolini G, Cravedi P, Duso C, Molinari F. 1992. Lepidotteri dei fruttiferi e della vite. Copyright by Bayer S.p.A. Milano. With permission from Bayer CropScience S.r.I., Milan, Italy.

The second- and third-flight female moths lay eggs individually on shaded berries. Shortly after the larva emerges it enters a berry and hollows it out as it feeds. A single bunch may be infested with several larvae. Webbing, frass, and fungal infection may result in extensive contamination of the bunch.


Larvae of European grapevine moth have prominent white spots at the base of the body hairs.

The lower and upper developmental thresholds are 50°F (10°C) and 86° F (30°C), respectively although some authors report that the lower threshold is as low as 7°C. Optimal development conditions are 79 to 84°F (26-29°C) and 40 to 70% humidity. Shorter day lengths and cooler temperatures initiate diapause. Although larvae may die when temperatures fall below 46.4°F (8°C), a diapausing pupa can withstand even the cold northern European winters. Some authors report that larvae die when the temperature exceeds 93°F (34°C).


Pupa of European grapevine moth inside its silken cocoon.

The first generation is shorter than the summer generations. Using the 50°F (10°C) and 86°F (30°C) lower and upper developmental thresholds, eggs hatch in about 118 degree-days Fahrenheit (DDF) or 66 degree-days Celsius (DDC). Larvae feeding on flower clusters are reported to develop faster than those feeding on grape berries later in the season, and this influences generation time. Nondiapausing pupae require about 234 DDF (130 DDC) to develop. Adult females may lay eggs about 110 DDF (61 DDC) after emergence. Estimates of DD for a generation vary considerably in the literature, from 767 DDF (427 DDC) to 1039 DDF (577 DDC) in the first generation to 868 DDF (482 DDC) to 1039 DDF (577 DDC) in later generations. While it is clear that research needs to be done in California to clarify developmental time, our preliminary estimate would be about 833 DDF (463 DDC) for the first generation and 904 DDF (502 DDC) for the second generation.

Monitoring

Sex pheromone attracts males and is used to monitor male flights. Before bud break, place red delta-style traps with *L. botrana* lures high in the canopy, preferably higher than 5 feet above the ground. Place at least one trap per 30 acres or per vineyard block if smaller. Change lures according to manufacturer's recommendations. Check traps weekly, recording the number of moths caught and removing trapped moths from the sticky trap bottom. Plot the weekly catches to determine initiation and peak of male flights in each generation. Continue monitoring with traps until the peak of the third flight.

Insecticide applications should be timed for larval emergence, thus monitoring egg laying and determining

egg hatch are essential to management of this pest. For the first generation, egg laying should be monitored from the peak until the end of the flight. Search for eggs on the peduncle of 100 clusters, selecting one cluster per vine. Note the stage of the majority of the eggs found. Eggs are white when recently laid, turning yellow and later black when larvae are near emergence. A translucent egg chorion indicates the larva has emerged. After egg hatch, look for webbing of flower parts. Open up the webbing and look for feeding damage and larvae.

Begin monitoring for second- and third-generation eggs on berries one week after the first moths of the respective flight are caught in the traps. Continue monitoring for eggs weekly until one week after peak flight. Inspect 100 bunches, selecting one per vine. Continue monitoring bunches for feeding damage (holes or hollow berries), webbing, and presence of larvae.

Management

In countries where *L. botrana* is established, control measures are targeted at the second generation. This is due in part to the prolonged emergence of the first generation and because of possible reinfestation from untreated neighboring vineyards. However, treatment of the first generation is recommended if populations are high or if treatments are conducted on an area-wide basis. Under California conditions, control of both first and second generations may be warranted, given that this is a newly introduced pest. Insecticides are less effective after bunch closure.

Several reduced-risk insecticides are registered for use in grapes to control tortricid larvae. These include insect growth regulators, spinosyns, and *Bacillus thuringiensis*.

Mating disruption has been studied in Europe for several years. It has proven most effective when grapevine moth populations are low and when applied to large areas of over 10 acres or areawide. Since this is a newly reported pest, no *L. botrana* pheromone mating disruption products are currently registered in the United States.

Numerous predators and parasitoids are reported in the European literature. Among the parasitoids are 4 species of tachinid flies and nearly 100 species of parasitic wasp in the ichneumonid, braconid, pteromalid and chalicidoid families. The parasites that are reported to cause the greatest impact are those attacking the overwintering pupa. In Spain these include the pteromalids *Dibrachys affinis* and *D. cavus*, which are reported to cause up to 70% pupal mortality, whereas in Italy the ichneumonids *Dicaelotus inflexus* and *Campoplex capitator* are the most important.

Authors

Lucia G. Varela, UC Cooperative Extension and Statewide IPM Program
Frank Zalom, Department of Entomology, UC Davis
Monica Cooper, UC Cooperative Extension, Napa County

Acknowledgements

We thank Jeffrey Erwin, Napa County Agriculture Commissioner's Office and Marc Epstein, California Department of Food and Agriculture Plant Pest Diagnostic Center for the review of this manuscript.

References

Armendáriz I, Campillo G, Pérez-Sanz A, Capilla C, Juárez JS, Miranda L. 2007. La polilla del racimo (*Lobesia botrana*) en la D.O. Arribes, años 2004 a 2006. Bol. San Veg. Plagas 33: 477-489.

Briere JF, Pracros P. 1998. Comparison of temperature-dependent growth models with the development of *Lobesia botrana* (Lepidoptera: Tortricidae). Environ. Entomol. 27: 94-101.

Coscollá Ramón R. 1981. Algunas consideraciones sobre la dinámica poblacional de *Lobesia botrana* Den. Schiff. en las comarcas vitícolas valencianas. Bol. Serv. Plagas 7: 169-184.

Coscollá Ramón R. 1998. Polillas del racimo (*Lobesia botrana* Den. Y Shiff.). In Los parasitos de la vid, estrategias de proteccion razonada. Madrid, Spain. pp. 29-42.

Del Tío R, Martínez JL, Ocete R, Ocete ME. 2001. Study of the relationship between sex pheromone trap catches of *Lobesia botrana* (Den. & Schiff.) (Lep., Tortricidae) and the accumulation of degree-days in Sherry

vineyards (SW of Spain). J. Appl. Ent. 125: 9-14.

Gabel B, Mocko V. 1986. A functional simulation of European vine moth *Lobesia botrana* Den. Et Schiff. (Lep., Torticidae) population development. J. Appl. Ent. 101: 121-127.

Gallardo A, Ocete R, López MA, Maistrello L, Ortega F, Semedo A, Soria FJ. 2009. Forecasting the flight activity of *Lobesia botrana* (Denis & Schiffermüller) (Lepidoptera, Torticidae) in Southwestern Spain. J. Appl. Entomol. 133: 626-632.

Louis F, Schmidt-Tiedemann A, Schirra KJ. 2002. Control of *Sparganothis pilleriana* Schiff. and *Lobesia botrana* (Den. & Schiff). in German vineyards using sex pheromone-mediated mating disruption. Bull. IOBC/WPRS 25: 1-9.

Maher N. 2002. Sélection du site de ponte chez *Lobesia botrana* (Lepidoptera: Tortricidae): influence de l'infromation chimique non-volatile présente sur les fruits de plantes hôtes. Thése N° 968, Université de Bordeaux 2. pp. 204. http://www.inra.fr/theses/these-integrale/Theses/maher/pdf/these.pdf

Maher N, Thiéry D. 2006. *Daphne gnidium*, a possible native host plant of the European grapevine moth *Lobesia botrana*, stimulates its oviposition. Is a host shift relevant? Chemoecol. 16: 135-144.

Masante-Roca I, Anton S, Delbac L, Dufour MC, Gadenne C. 2007. Attraction of the grapevine moth to host and non-host plant parts in the wind tunnel: effects of plant phenology, sex, and mating status. Entomol. Exp. Appl. 122: 239-245.

Milonas PG, Savopoulou-Soultani M, Stavridis DG. 2001. Day-degree models for predicting the generation time and flight activity of local populations of *Lobesia botrana* (Den. & Schiff.) (Lep., Tortricidae) in Greece. J. Appl. Ent. 125: 515-518.

Moreau J, Benrey B, Thiéry. 2006. Grape variety affects larval performance and also female reproductive performance of the European grapevine moth *Lobesia botrana* (Lepidoptera: Tortricidae). Bull. Entomol. Res. 96: 205-212.

Sáenz-de-Cabezón F, Maron V, Zalom F, Pérez-Moreno I. 2005. Effects of methoxyfenozide on *Lobesia botrana* (Den & Schiff) (Lepidoptera: Torticidae) egg, larval and adult stages.

Thiéry D. 2008. Les Tordeuses nuisibles à la vigne. In Les ravageurs de la vigne. Féret, Bordeaux. pp. 15.

Torres-Vila LM, Stockel J, Roehrich R, Rodríguez-Molina MC. 1997. The relation between dispersal and survival of *Lobesia botrana* larvae and their density in vine inflorescences. Entomol. Exp. Appl. 84: 109-114.

Xuéreb A, Thiéry D. 2006. Does natural larval parasitism of *Lobesia botrana* (Lepidoptera: Torticidae) vary between years, generation, density of the host and vine cultrivar? Bull. Entomol. Res. 96:105-110.

Zangheri S, Briolini G, Cravedi P, Duso C, Molinari F, Pasqualini E. 1992. *Lobesia botrana* (Denis & Schiffermüller). In Lepidotteri dei fruttiferi e della vite. Milan, Italy. Pp. 85-88.
