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Risk Assessment: Exemption of Wine Grapes from Regulated Status in the Light Brown Apple Moth Federal Quarantine Order Based on Production Practices

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Background

From the time light brown apple moth, *Epiphyas postvittana*, was discovered in California in 2006, APHIS and the California Department of Food and Agriculture (CDFA) have taken steps to prevent the spread of this pest by implementing the *E. postvittana* Federal Domestic Quarantine Order (APHIS, 2007). This Federal Order defines quarantine areas and restricts the movement of numerous agricultural commodities.

For some of the regulated commodities, the likelihood of spreading *E. postvittana* may be sufficiently low to justify exempting these commodities from the quarantine, based on pest biology and specific industry practices.

Previous Plant Protection and Quarantine (PPQ) documents (APHIS, 2012a, 2012b, 2013a, 2013b) have led to the exemption of several commodities from the Light Brown Apple Moth program requirements, including table grapes. The current document is in response to a request from the Agriculture Commissioners of Napa, Sonoma and Monterey Counties in California to exempt wine grapes from all intrastate regulatory requirements contained in Title 3, Division 4, Chap. 3, Sect. 3434 *E. postvittana* Interior Quarantine (G. Clark personal communication, February 13, 2015).

Conditions necessary for *E. postvittana* to spread

Epiphyas postvittana are primarily leaf feeders, webbing leaves together to form shelters from which they feed. When leaf shelters occur near fruit, larvae may occasional web leaves grape bunches and feed externally on the grapes (Lo and Murrell 2000; Danthanarayana 1975). The feeding can cause berries to collapse and provides entry points for fungal infections of organisms such as *Botrytis cinerea* (Lo and Murrell, 2000). Pupation occurs within the larval nest (Danthanarayana, 1975). Adult moths do not feed on fruit and typically oviposit on the upper surface of leaves (Buchanan 1977). Thus, the life stages that could be associated with grapes are the larval and, potentially, the pupal stage.

The *E. postvittana* population in California has been expanding despite quarantine areas established by APHIS and CDFA (Suckling et al. 2014). Quarantine areas greatly reduce the probability that pest populations will spread, but populations can escape quarantine zones due to factors outside of regulatory control. Under certain conditions the moth could escape the quarantine area through flight. Suckling et al. (1994) captured female moths 275 m from release points, but the recapture rate was very low, and farther flights could not be ruled out. Danthanarayana (1976) noted environmentally induced changes in *E. postvittana* wing morphology and postulated that the moths have a strong migratory ability under certain situations. *Epiphyas postvittana* has a large host range and has been found on at least 30 genera

in California (Brockerhoff et al. 2011) many of which presumably grow in very close proximity to quarantine areas.

The moth could also escape quarantine through illegal or unintentional movement of propagative material out of the quarantine area. This is the most likely scenario for long distance movement, and may well be the mechanism by which *E. postvittana* arrived in the United States. Suckling et al. (2014) saw evidence of human aided movement when new populations became established long distances from quarantine areas. The quarantine prohibits commercial movement of certain hosts out of the quarantine area, but would do little to prevent private citizens from moving personal plants. The most likely scenario for starting new populations would be by moving plants containing egg masses. Each egg mass contain an average of 35 eggs (Danthanarayana, 1983) and could give rise to numerous new larvae in a suitable new location. The scenario is particularly well suited for founding new populations because eggs and larvae are moved with their host under optimal conditions for host survival, and illegally moved propagative material is obviously not inspected.

Wine grapes as a pathway

In comparison with natural movement through flight or the illegal movement of whole plants, wine grapes appear to be a particularly poor pathway for moving *E. postvittan*a. For the moth to be spread outside of the quarantine area on harvested wine grapes, and become established in a new location, viable life stages must undergo *all* of the following events:

1. be present on grape fruit in the field at the time of harvest
2. remain on the fruit through harvest, inspection, packing and processing.
3. survive shipment
4. arrive in an area suitable for establishment and escape into the environment
5. complete development to the adult stage
6. find and mate with a partner of the opposite sex.
7. the mated female must find a host plant on which to oviposit
8. eggs must hatch and larvae develop to adulthood in numbers sufficient to produce a breeding population.

Several factors make the aforementioned events unlikely and mitigate risk.

<u>Low field prevalence</u>

Wine grape growers in California practice Integrated Pest Management (IPM) guideline as outlined by the University of California (Bettiga 2013; UC IPM 2014; California Winegrape Work Group 2009). This includes regular vineyard monitoring, surveys and trapping to determine pest populations and economic thresholds (Bettiga 2013; UC IPM 2014). The most common lepidopteran pests that California wine grape producers monitor and treat for are moths such as: orange tortrix (*Argyrotaenia franciscana*) (Bettiga 2013; UC IPM 2014), omnivorous leafroller (*Platynota stultana*) (Bentley 2009), and light brown apple moth (LBAM) (*Epiphyas*

postvittana) (Bettiga 2013; UC IPM 2014). Growers identify treatment options that provide the best efficacy and try to use the least toxic chemical treatments and control measures available - such as *Bacillus thuringiensis* (Bt), mating disruption pheromone, and promoting the activity of natural enemies by using minimally disruptive IPM methods (Bettiga 2013; UC IPM 2014) .

All appropriate records are retained by growers. This includes field monitoring, survey, and training records as well as pesticide use reports, which are submitted to County Agricultural Commissioners, and made available to program officials upon request. Additionally, growing practices can decrease the chance of transporting LBAM in grapes. For instance, at véraison during the growing season, grape leaves are removed from grape clusters to increase exposure to the sun to aid in ripening and pesticide/fungicide treatment (Pence and Grieshop 1991; Margalit 1996; Striegler and Jones 2012)

Harvest and Post-harvest procedures

Wine grapes are harvested either by hand or by mechanical processing (Margalit 1996; Taylor 2012). For hand processing, growers are selecting grapes for high quality and remove leaves and debris from the clusters or bins (Personal Communication: G. Clark Napa County Office of the Agricultural Commissioner 2015; Lanza Vineyards 2015). Removing leaves will remove any LBAM nests attached to leaves on the clusters. Additionally grapes infested with insects or have larval feeding damage are discarded as hand-picked grapes are selected for high quality (Personal Communication: Lanza Vineyards 2015).

Mechanically harvested grapes are picked with machines that strike the vines with flexible rods or grasp the trunk and shake the grapes off onto conveyor belts that transport the grapes into large bins. Modern harvesters use blowers to eliminate much of the leaf debris that would make it into the bins (Taylor 2012). Once in the bins, many of the grape skins break releasing juice (Bisson 2001). Any LBAM larvae that may have made it into the bins on grapes or leaves would then be suffocated by the weight or the grapes or drowned in the juice. Most of the wine grapes harvested in the light brown apple moth distribution area are either transported to a local facility where they are crushed (for local use or shipment to wine makers as must) or shipped as whole grapes to small wine makers or hobbyists who wish to crush their own grapes. While there are some shipments of whole grapes out of state to small wine makers or hobbyists who wish to crush their own grapes to make wine, this overall is a very small volume of the total of wine grapes produced in California. (Personal Communications: H. Izquerido, Napa County Office of the Agricultural Commissioner; S. Ostrom, Sonoma County Office of the Agricultural Commissioner; L. Pinfold Solano County Office of the Agricultural Commissioner; T. Gonzalez, Monterey County Office of the Agricultural Commissioner; Lanza Vineyards June 2015)

Grapes for local processing:

Wine grapes are processed by destemming and crushing and followed by either fermentation for

red wine grapes or pressing for white wine grapes or by pressing whole clusters without destemming and crushing to collect juice for fermentation (Margalit 1996). Grapes processed for red wines are allowed to sit in the wine juice (must) during fermentation and are then pressed. White wines have the grape skins removed after pressing and before fermentation. Crushing and pressing grapes destroys lepidopteran larvae and pupae.

A study by the California APHIS-PPQ-CPHST lab on processing grapes artificially infested with LBAM showed mortality for both red and white wine grape processing. For red wine making, larval mortality of 91% was observed after crushing but reached 100% mortality after 48-65 hours or more in must. For white wine, in addition to mortality caused by crushing, pressing also causes mortality with observations of pupal mortality of 99.7% after pressing at 1.5 bars and 100% mortality at 1.8 bars. (Internal Report, USDA-APHIS-PPQ-CPHST).

Smith et al. (2011) and Varela et al. (2013) tested the effect of desteming and crushing and of pressing whole grape clusters on *Lobesia botrana* larvae, a tortricid moth with similar biology to *E. postvittana*. Smith et al. (2011) determined that destemming alone caused 81 percent larval mortality. The grapes were pressed at pressures of 1.5 and 1.8 bars. Only a single larva survived the 1.5 bar press cycle and no larvae survived the 1.8 bar press cycle. In a study where whole grape clusters were pressed with and without first crushing and destemming Varela (2013) showed 100% mortality at pressures of 1 and 2 bars. All of these studies showed that wine grape processing destroys larval and pupal life stages.

Grapes for delivery to small wineries and hobbyists (Lanza Vineyards, personal communication, June 2015)**:**

Grapes are harvested by hand where they are cut from the vine using pruning shears, and placed immediately into clean, new plastic boxes (lugs) lined at the bottom with an absorbent pad. Since larvae feed externally on bunches, webbing the grapes together with leaves (Lo and Murrell 2000; Danthanarayana 1983), hand selection reduces the likelihood that infested grapes are harvested. Individual berry clusters are inspected for quality and freedom from pests prior to being placed in lugs (G. Clark Napa County Office of the Agricultural Commissioner personal communication 2015; Lanza Vineyards personal communication June 2015). During the harvest, the boxes are moved along the row on platform wheel barrows (3 boxes per wheel barrow load). Once pallets are loaded with full boxes, they are moved directly to the shop area. Here they may briefly be placed on pavement before being moved to a refrigerated trailer at 34°F. The cold temperature for storage and shipment prevent larvae from developing. The lower development threshold for LBAM larvae is 45.5° F (Danthanarayana 1975), which is warmer than the standard refrigeration temperature for grapes.

Refrigerated trailers are delivered prior to harvest and are pre-cooled and ready for receiving loaded pallets prior to harvesting. Prior to shipping, the trailers are equipped with a temperature recording device such as a Hobo or Ryan monitor. Trailers are picked up for Eastern Seaboard

destinations such as New York, New Jersey and Connecticut. Grapes are used at destination by boutique wineries and hobbyists to ferment wine.

The likelihood that unprocessed grapes, infested with at least one male and one female LBAM larva would be discarded together by an end consumer, and that the larvae would be able to complete their development and reproduce successfully is also extremely low and provides an additional layer of safety.

Recommendation

Based on production practices, grapes infested with *E. postvittana* are unlikely to be shipped out of quarantine areas. Furthermore, because wine grapes are processed the likelihood of larval survival and escape from the pathway is very low, whether fruit is processed locally or elsewhere in the country. We recommend that wine grapes be exempted from the *E. postvittana* regulated article list with the understanding that producers continue their current IPM, harvesting, and post-harvest practices.

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