REPORT OF THE TECHNICAL WORKING GROUP
FOR THE
EUROPEAN GRAPEVINE MOTH PROGRAM

Sacramento, California
October 30 – November 1, 2012

A subset of the Technical Working Group (TWG) for the European grape vine moth (EGVM) program in California met in Sacramento, CA, from October 30 to November 1, 2012. TWG members attending: M. Cooper, A. Lucchi, L. Sazo, G. Simmons, R. Steinhaur, and L. Varela. Three additional members attended all or portions of the meeting via webinar/teleconference: R. Cardé, D. Lance and V. Mastro (TWG Chair). The latter two were not present in Sacramento due to flight cancellations resulting from Hurricane Sandy. The following members were not in attendance: B. Bagnoli, G. Barrios, C. Ioriatti, R. Sforza, and G. Wegner-Kiss. On October 30, program personnel from federal, state, and county levels provided the TWG members in attendance with a summary of activities and results from the previous seasons. Following that, the TWG met separately to formulate responses to a series of questions from the program and draft recommendations on guidelines for deregulating areas as the program progresses. A preliminary report to the program was delivered verbally on the morning of November 1.

Overview

At this point, the TWG believes that a wide variety of program goals, including eventual eradication of EGVM from California, remain technically feasible. Following its April 2010 meeting, the TWG provided three conditions for the continued feasibility of eradication. To reiterate:

1. The population is not (and does not become) substantially more widespread than it is known to be at present,
2. The grape industry remains behind the effort, and
3. Control methods that are available at the present time remain available for use by the program.

All three are still applicable. Numbers of European grapevine moth, *Lobesia botrana* (EGVM), have been substantially reduced each year of the program within the core of the infestation (Napa area). In addition, no EGVM were captured in outlier counties in 2012, allowing for the deregulation of all areas except Napa County and some abutting portions of Sonoma and Solano Counties. Also, none of the chemical or behavioral (mating disruption) control tools have been lost or become ineffective. Finally, the grape industries have remained solidly behind, and involved with, the program. The TWG commends their efforts and recognizes that they have collectively borne the brunt of treatment costs and, along with growers of other affected crops, the burden of regulatory measures. In addition, program officials at the federal, state, and county levels have continued their very good job of coordinating and ensuring compliance with program activities.

Eradication, as well as a number of other potential goals (e.g., containment or suppression), will continue to require a well-designed and well-coordinated area-wide program. As the program progresses, potential snags may develop, as illustrated this year by the discovery of a small private vineyard in the Olive Hill portion of Napa that harbored a significant residual EGVM population. Residential and natural areas continue to be of concern as, compared with commercial vineyards, they are more difficult to survey and options for control treatments are more limited. In addition, while not a technical issue, TWG members expressed concern among themselves that grower enthusiasm for the program may begin to flag now that moth populations are not apparent in many areas but treatment costs continue. In both cases, sufficient and timely funding will be important to support program staff and activities required, and, if possible, to help defray treatment costs to growers.

Specific recommendations

The TWG was provided with lists of specific questions prior to this meeting. Most of these questions had to do with the process of deregulating areas where EGVM had existed. We believe that most or all of these specific questions are answered below directly or in some cases that the answers can be found by following through the recommended protocols.

Quarantine buffer:

The TWG continues to recommend that the regulated area is encompassed in a 3-mile buffer around the sites of *any* EGVM finds, whether they are trap catches or visual finds.

Quarantine triggers:

The TWG is not recommending specific changes for quarantine triggers in areas that are not regulated for EGVM or have been released from EGVM quarantine.

The TWG is recommending a programmatic trigger of 1 life-stage (an adult in trap or an immature) within the regulated zone in the Napa County area. That is, finding a single insect will kick off a program response in terms of trapping levels and control activities, and will reset the deregulation "clock" for areas within 3 miles of the find. The rationale is that populations have been driven low enough that transport of single moths to points outside of infested areas will be rare, so a moth find is likely an indication of local breeding population.

Survey recommendations (unregulated areas):

The TWG's recommendations for survey in unregulated areas have changed little from those developed during the November 2010 meeting. At the time of this meeting, the TWG is projecting that no areas beyond the large central infestation in the Napa area will remain regulated in 2013. Trapping recommendations for the Napa area are discussed separately in *Deregulation*, below.

1. Survey levels
    a. California grape production areas should have no fewer than 25 traps per square mile for the entire trapping season (Feb-Oct 1).
    b. Priority should be given to trapping the areas within 300 m of grape processing facilities (e.g., wineries), and especially those that have received grapes from regulated areas. In addition, any vineyards within that area, no matter how small, should have at least one trap. The TWG recognizes that factors such as budget shortfalls can potentially make it impossible for the program to meet recommended or protocol trapping levels in some areas. The history of EGVM in California indicates that most finds of the moth in remote counties has occurred in the vicinity of wineries, which is why these areas are priorities for survey. However, there have been additional EGVM finds in vineyards that were remote from wineries so all grape production areas should be trapped if possible.
    c. Delimitation: 100 traps per square mile. This should be conducted within the core square mile of all new finds for 1 *full* generation (or, more correctly, one full flight). In Napa, for example, a full generation would include the first or second flight of the year but not the third, as a proportion of the population may enter diapause after 2 generations and thus would not be sampled by trapping the 3rd flight.
    d. At-risk urban areas in California should be surveyed at 5 traps per square mile. These include areas near grape production areas or areas with backyard grapes. "Near" would be a minimum of 500 m but could increase to 1 to 3 miles with risk factors such as high proportions of yards with vines or proximity to current or previous EGVM infestations. This trapping can be piggy-backed onto other trapping programs where applicable.

e. The TWG strongly supports current APHIS efforts to survey nationwide for EGVM.

2. Timing of trapping.

   Trapping should commence in the late winter or spring before the predicted start of the adult flight season, based on degree-day modeling (at ~150 DD Celsius, 10-30 deg base, with January 1 as the starting point for accumulating DD). Trapping should continue until at least October 1. No EGVM have been captured in California after October 15, so there is no need to trap after this date. Further, given the minimal captures in the first half of October, the TWG felt that the benefit from trapping during this period does not justify the effort, especially if traps interfere with harvest or vice versa. Note that diapause occurs in the pupal stage in EGVM and is controlled primarily by photoperiod. As a result, weather – aside from temperature effects on the duration of the pupal stage – will have relatively little influence on the calendar date when the flight season ends.

3. Trap placement.

   Traps that are placed at a specified density (i.e., a proscribed number of traps per square mile) should be spaced as uniformly as possible throughout the area being trapped. For example, if 25 traps per square mile are arrayed on a "perfect" square grid, traps will be 322 m apart, and maximum distance between two traps within the area (mid-point on the diagonal between traps) will be 228 m. To keep the maximum insect-to-trap distance near or below 228 m, traps need to be placed within and not just at the perimeter of any vineyards that exceed ≈325 m across in the shorter dimension (length or width). See Appendix I for details and the rationale for this recommendation.

   Within vineyards, place traps at canopy height.

4. Visual inspections.

   The TWG recommends the use of visual inspections of grapes for immature EGVM, especially in areas under mating disruption treatment. These should be conducted during first generation of the year:

   - Inspect 100 clusters at 25 trap sites per square mile in treated areas.
   - Inspections should be made during the period from the beginning of flowering to fruit set.
   - Inspections would be expected to require 15-20 minutes per 100 clusters.

5. Other considerations:

   a. Trap-check frequency. The TWG continues to recommend a 2-wk trap-servicing interval to ensure captured moths are in good condition for identification.

   b. Second-generation diapause. In areas of California, including the Napa Valley, a portion of the population appears to go into diapause following the second annual generation (i.e., they overwinter as pupae rather than emerging as adults as part of the third flight). This has also been observed in other areas where EGVM occurs. Second-generation diapause can affect our ability to detect the population via trapping during the third flight. It can also affect calculations of the overall number of generations a population passes through.

Treatment recommendations

Options for control treatments remain similar to those in 2010 recommendations.

1. Chemical treatments in commercial vineyards

   a. Treat to a 500-m radius around finds (trap or larval) collected at any time during 2011 or 2012.

   b. Treat first and second yearly generations while the area is under regulation.

c. Timing based on DD models and host phenology (first annual generation) and primarily DD models (second generation).

d. The current list of available insecticides remains appropriate. Methoxyfenozide ("Intrepid") and Chlorantraniliprole ("Altacor") have been the most commonly used options and have been very effective, but growers (or program managers) should continue to select products based on situation and need. For organic production, Bt and spinosads ("Entrust") are the available options. These insecticides have a short field residual and can require multiple applications per generation to be effective.

2. Mating disruption in commercial vineyards

   a. Treat to a 500-m radius around sites of 2012 EGVM finds (trap or larval). Also, treat to 500 m around sites of any 2013 finds in the Napa area. If EGVM captures indicate the presence of a population at a remote location beyond the Napa infestation, use of mating disruption is at the discretion of the program based on a variety of factors, including the apparent size of the population and the efficacy of the other control measures being used.

   b. Apply prior to first flight of the season (2012 sites), based on degree-day models.

   c. Do not apply to areas surrounding 2010 or 2011 finds, unless those areas are also within 500 m of 2012 or 2013 finds.

   d. When mating disruption is used in residential areas, cover the area surrounding the find(s) as uniformly as possible out to 500 m. Some alternative formulations may become available pending analysis of data from recent field trials in Italy and/or results of future research. If so, some of these formulations may have application methods that could be useful for improving uniformity of coverage in back yards and other difficult-to-reach areas.

3. Residential, urban, and natural areas. Continue to use host removal or Bt, in combination with mating disruption when practical, for all 2011 and 2012 EGVM finds. The use of mating disruption continues to be strongly favored by TWG members, except in areas targeted for deregulation, as described below.

Alternate and secondary hosts

The TWG does not have recommendations in this area at this time, other than to continue treating flowering olives as potential hosts. Applicable recommendations on EGVM host plants can be found in previous TWG reports and in several communications that came out following the 2011 TWG meeting.

Regulatory treatments

At this time, the TWG is not recommending any changes in regulatory policies, including those involving winery waste, movement of grapes or grape plants, systems approaches to fresh grape certification, other grape products such as must.

Deregulation

The TWG recognizes that, as the EGVM program progresses; it is desirable to keep all infested areas under regulation, but to lift regulations as quickly as possible from areas where the insect has been eradicated. There are two associated "error states" – specifically, (1) lifting regulations from an area where the pest still exists and (2) keeping an area under regulation after the pest has been eradicated. While neither of these error states is desirable, the former would be much less so, as finding a population in an area that has been declared pest-free – especially if there are multiple incidents – will tend to erode confidence of the public, the industry, and our trading partners. Declarations that areas are pest-free are based primarily on sampling, which for EGVM is done with pheromone-baited traps and in some cases by visual examination of vines. Such sampling can never provide 100% assurance that a population of the pest isn't present, but the ability to detect a population, and especially a small population, increases with

the intensity (e.g., traps per square mile) and the duration (moth generations) of the sampling effort. Determining the success of eradication efforts is further complicated with EGVM because we do not have a good understanding of the efficiency or effective sampling range of the traps. With these factors in mind, the TWG has developed strategies for deregulation that we believe will minimize the risk of type (1) errors without placing an undue burden on affected industries.

Recommendations for deregulating populations in outlying counties were outlined previously and were largely followed by the program, leading to deregulation. Specifically, the TWG at this time supports deregulating Nevada, Santa Clara, and Santa Cruz Counties as well as all portions of Sonoma County that are beyond the 3-mile buffer from finds in neighboring portions of Napa County. From 2013 on, barring additional finds in outlying areas, only the Napa County program area (which also includes small portions of Solano and Sonoma counties) will be regulated. In the outlying areas, infestations tended to be very small and isolated, and the control measures applied very likely reduced those populations to points where they are no longer viable. In the Napa area, initial populations were much larger and covered a much broader geographic area, making it relatively much more likely that pockets of infestation have persisted through the treatments. As a result, the TWG is recommending more stringent protocols prior to release from regulation for the Napa area.

1. Areas within three miles of EGVM finds should be regulated (no change).
2. General detection trapping within the entire regulated area should be increased to 100 traps per square mile for grape production areas and 25 traps per square mile in urban areas.
3. When a life stage of EGVM is detected, production areas within 500 m of the find should be:
    a. Treated with program-recommended insecticides during the first and second generation of each year until the area is deregulated.
    b. Treated with mating disruption for two *full* flights following the detection. As noted above, in the Napa area, the third flight of the year typically includes only a portion of the population and cannot be counted toward mating disruption treatments or as a flight for confirmatory trapping prior to deregulation. Trapping levels may be reduced to 25 traps per square mile for areas under active mating disruption treatment.
    c. Surveyed visually for EGVM larvae in vineyards treated with mating disruption per protocol above under *Survey recommendations*/Visual inspections.
4. In the second year after the detection (the year following mating disruption), increase trapping within 500 m of previous finds to either 250 or 100 traps per square mile in production areas depending on the duration of trapping (see below), 100 traps per square mile in urban and residential areas, and 25 traps per square mile in any riparian or wild areas that may be harboring wild or feral grapes.
5. If there are no additional finds in the area after three full flights of high-density trapping (and at least five full flights after the initial find), the area becomes eligible for deregulation if 250 traps per square mile were deployed in vineyards within 500 m of earlier finds. An alternative strategy would be to deploy 100 traps per square mile in those core production areas and extend the trapping period to four full flights (and at least six full flights after the initial find). Note that active mating disruption dispensers cannot be present in areas where high-density trapping is being used to confirm eradication.

    The TWG recognizes that its preferred option of trapping at 250 traps per square mile across the entire program area (within 500 m of finds) may not be feasible. Assurances that persistent breeding populations do not exist in an area can be achieved by increasing the duration of trapping and/or trapping density. Because of this, an extra generation of intensive trapping will be needed if the program opts for 100 traps per square mile rather than 250 within 500 m of previous finds.

As noted above, traps should be spaced as uniformly as possible throughout the area being trapped in order to keep the maximum insect-to-trap distance as small as possible. More specifically, at 100 traps per square mile, traps should be arrayed so that no point in the vineyard is more than ≈120 m from the nearest trap; at 250 traps per square mile, all points should be no more than ≈75 m from the nearest trap. This will require placing traps within, and not just at the perimeters of, larger vineyards. Guidelines and rationale for this recommendation are given in Appendix I.

The TWG also had internal discussions as to whether it would be better to suspend insecticide treatments prior to the last one or two full flights. The thought was that this would allow any residual population to grow, which would improve our odds of detecting it. The counter-argument was that any population that was small enough to require growth to ensure detection would probably be eliminated by the additional treatments. Because the latter option potentially hastens deregulation and simplifies/shortens the program, we chose it.

6. If these recommendations are adopted and followed, and no additional moths are captured in the Napa area, most of the current regulated area would be eligible to be deregulated after the completion of first moth flight of 2014. The exception would be areas within three miles of any 2012 finds, which would not become eligible for deregulation until after the completion of the first flight of 2015.

7. Since the beginning of the program, the TWG has maintained that when Napa County is deregulated, it should be done in fairly large contiguous blocks and preferably from the outside in, as opposed to, say, deregulating individual vineyards or individual square-mile areas in a patchwork fashion. At this point, the TWG believes that, for example, if no additional EGVM were trapped in Napa, an acceptable plan would be to simply follow protocol; i.e., release all areas of the county at the same time except for areas within 3 miles of 2012 finds – those areas would then be released as a block a year later. However, it is likely that additional EGVM will be found in the Napa area in 2013 and perhaps beyond. If there are more finds but they are restricted to one or a few additional areas, deregulation could likely still proceed simply by following proscribed protocols. However, if there are numerous finds in 2013 that are scattered throughout the county, it may be preferable to re-draw larger contiguous blocks that include multiple small blocks that would otherwise be deregulated at staggered intervals. Patterns of future finds are impossible to predict at this point, but the TWG is willing to provide recommendations in this area if and when they are needed to supplement Napa's deregulation protocols. The other consideration here, and one that the TWG has only limited knowledge to address, is how the movement of grapes within the Napa area might influence optimal spatial patterns for deregulation.

Appendix I. Rationale for within-vineyard trapping

The probability of detecting an insect population with traps (that is, catching at least one insect from the population) is a function of the number of insects in a population and the likelihood that any given insect in that population will be captured. One of the key factors in determining the likelihood of capturing an insect is the distance between that insect and any surrounding trap. Specifications of trap density for such purposes as detecting populations are really mechanisms to ensure that distances from traps to the cores of small populations do not exceed some maximum, beyond which the probability of catching an individual insect becomes so low that the population would have to grow unacceptably large before we would have a high degree of assurance that we would detect it. When attempting to demonstrate eradication, the trapping system must be designed to have a high probability of detecting even a very small population. Though it is technically impossible to "prove" eradication by trapping alone, if trapping is continued across multiple generations, we can develop an acceptable degree of assurance that a viable breeding population doesn't exist in the area.

In order to keep the maximum insect-to-trap distance acceptably small, trap-density specifications assume that traps will be spaced relatively uniformly within the trapped area. At 100 traps per square mile, for example, traps arrayed on a "perfect" square grid will be approximately 161 m apart, which results in a maximum insect-to-trap distance (where the insect is at the center of a square) of about 114 m (note that a truly optimal array of traps is achieved by placing each trap at the corner point of an equilateral triangle instead of a square. In that case, inter-trap distance becomes 173 m but maximum distance from any point on the plane to the nearest trap is reduced slightly to 107 m). In practice, traps are never perfectly arrayed, and maximum potential insect-to-trap distances will be somewhat longer than those listed above. However, in agricultural settings such as vineyards, any point within the field should be as accessible as the next, and it should be possible to position traps close to design optima.

The resulting recommendation is to place lines of traps internally in all vineyards that exceed 102, 161, or 322 m in width for trap densities of 250, 100, and 25 traps per square mile, respectively. Of course, trapping can also be conducted inside vineyards that fall below the sizes noted above, and doing so will improve detection sensitivity. One caveat here is that trapping within vineyards *only*, as an alternative to perimeter trapping, is not recommended if it reduces the total number of traps in the local area, which could reduce sensitivity of the local detection array.

Appendix II. Research needs, unprioritized, from 2010 report *(annotated with updates in italics)*

Monitoring:

- Determine the utility of high-load pheromone lures, light traps, food-lure traps, etc., for monitoring EGVM populations in areas under mating disruption treatments. *Studies on high-load pheromone lures were conducted in Italy in 2012 and the results suggest that 5X loads may be useful for monitoring under mating disruption. In addition, studies on female attractants have been initiated in New Zealand with cooperative field testing in Italy, though these field results suffered from low populations of EGVM in the study area.*
- Develop/validate sampling systems for assessing populations of immature EGVM in fields (for use in monitoring to assess risk of moving grapes out of quarantine zone for crush and for assessing mating disruption effectiveness). *Research has not been done specifically in this area, but a recommendation based on European sampling plans is included here.*
- Optimize trap design (includes looking at folding of flaps in delta traps). *This has not been pursued. Studies had been proposed in Europe but last year's studies focused primarily on the lures rather than the traps themselves.*
- Determine sensitivity of the detection and delimitation systems (would have to be done abroad at this point). *There was a bit of release-recapture done in Italy in 2012 but studies were not specifically designed to address this*.
- Validate the degree-day model. *This work is ongoing in California and making good progress. Results are also being related to vine phenology.*

Ecology, behavior, biology, biological control:

- Continue work to determine what alternative hosts are used by EGVM in California. *There was a re-assessment of the literature in the past year that resulted in some recommendations. There may be less urgent now that only the Napa area is being regulated.*
- Determine factors that control entry into diapause; i.e., is it possible that many EGVM in Napa go through only two generations in a growing season?
- Evaluate genetic diversity in EGVM. *This work is ongoing in California.*
- Characterize adult behavior (flight, mating, oviposition, resting).
- Evaluate possibility of using biological control agents to reduce populations. *The success of the program in moving toward eradication has reduced the potential value of pursuing this, at least in the short term.*
- Characterize population dynamics of EGVM in California, including effects of natural enemies.
- Develop a spread model.

Control and management:

- Develop enhanced systems for monitoring and evaluating an area-wide EGVM management program.
    a. *Use GIS/GPS to track monitoring, treatment, and related relevant programmatic data (ongoing, APHIS-PPQ)*
    b. *Enhance tracking and evaluation of insecticide treatment data for Napa and Sonoma program areas (ongoing, UC Extension).*
    c. *Develop enhanced geospatial tracking and analysis of EGVM spread, control, and program activities in California (proposed).*

- Develop/assess new mating disruption formulations for EGVM, including machine-applied. *Field trials were initiated in Italy in 2012; results were presented during the TWG meeting.*
- Determine field life of mating disruption dispensers and how that affects the efficiency of pheromone-based trapping systems over time. *This is a new item for the 2012 report; there is some concern that if dispensers are left in vineyards, they could affect detection sensitivity the following year.*
- Continue to assess insecticides and develop lists of "best" insecticides for use in conventionally managed vineyards, organic vineyards, and sensitive areas (e.g., riparian, urban and suburban areas). Encourage registration of promising compounds and products for use against EGVM. Determine optimal timing and use patterns for products with short field life such as Bt. *Ongoing work, closely integrated with the program.*

Develop Sterile Insect Technique methodology for EGVM:

- Improved rearing technology. *This work is ongoing primarily in support of commodity treatment evaluations.*
- Radiation biology – identify dose and methods for producing fully sterile and F1-sterile male EGVM. *This work was initiated at the Otis lab but has not received funding; use of radiation as a potential phytosanitary treatment for EGVM was added as an objective.*
- Develop release technology. *We are not yet at the point where this or field evaluation is feasible.*
- Evaluate field competitiveness of sterile moths.

Regulatory:

- Develop and/or confirm regulatory treatments for grapes (table, wine, and raisin). *This work has been pretty well wrapped up.*
- Develop regulatory treatments for grape nursery stock; confirm efficacy of hot-water dip.
- Investigate pathways that could move EGMV to new areas. Also, how did it get to Napa?
- Evaluate/develop improved methods of transporting grapes within California to reduce incidence of new EGVM finds in the vicinity of wineries that are outside of regulated areas.
- Confirm efficacy of/develop improved methods for handling, composting, or otherwise treating winery waste to minimize risk. In particular, look at mechanical treatments for green waste (shredding, grinding, etc.). *Mechanical treatments and composting methods require additional evaluation. Methods involving mixing of green waste with wet fermented pomace wastes may also be assessed.*
- Determine if EGVM life stages can survive the crush process and survive in unfermented pomace. *Work in this area has led to recommendations to treat at 2 bars or higher to minimize risk.*
- Confirm that processing grapes into raisins will kill all EGVM life stages.