From the Bottle to the Bowl, Determining VectoMax® CG Application Strategies in Sonoma County, California

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ABSTRACT: The diversity of Sonoma County landscapes offers many challenges in the application of biorational mosquito larvicides, particularly in winery ponds and waste water treatment facilities. During the 2009 mosquito season, VectoMax ® CG[1] was used in multiple water retention sources utilizing a variety of field equipment at an application rate of 10 - 20 lbs/acre to control *Anopheles* and *Culex* mosquito species. This study evaluates seven separate mosquito sources where VectoMax® CG was used: four winery ponds, two waste water treatment ponds and one recreational lake. In most sources, we noted control lasting up to 21 days; however, beginning in late summer/early fall, a reduction in the length of control was noted at certain winery ponds. Following a laboratory trial to determine if the efficacy of the product was responsible, it was later determined that the fluctuation in water levels due to active grape crush was the real cause of the decrease in duration of control. This study outlines the efforts to determine the effectiveness of VectoMax ® CG for these sources, with emphasis on one winery pond.

INTRODUCTION

Marin/Sonoma Mosquito and Vector Control District (MVCD) began evaluating the efficacy of VectoMax® CG in various sources to determine where the product could effectively be used, which species were effectively controlled, what application rates would provide satisfactory results and how long the control lasted. District personnel were impressed by the quick knock-down provided by the product as well as the length of control observed in the field. It was determined that a retrospective evaluation of the sources treated with VectoMax® CG could provide the District with valuable information for the 2010 mosquito season.

Seven sources were selected for this retrospective evaluation, each with its own unique problems. For instance, Spring Lake Recreational Area typically produces *Anopheles* spp.; however, this year as an algal bloom began to decompose, the lake produced a large population of *Culex* spp. An application rate of 10 lbs/ac was used along the perimeter of the lake to control both the *Anopheles* and *Culex* mosquitoes. Some of the winery ponds chosen for this evaluation were too large to treat from land so boats were used to deliver the product into the thick vegetation in the middle of the ponds (i.e., Jackson Estate), whereas others winery ponds could be treated by walking the perimeter (i.e., Mazzocco Winery). An application rate of 10 lbs/ac was most frequently used at the winery ponds, with the exception of Martin Ray Winery, a highly organic and consistently problematic breeding source for *Culex* spp., which was treated at a rate of 18 - 20 lbs/ac. In addition, two waste water treatment plants with different levels of vegetation were evaluated for this study. Both treatment sites contained varying types of aquatic vegetation in addition to developing summer algal blooms. One of the treatment plants routinely produced *Cx. pipiens, Cx. tarsalis* and *Cx. stigmatosoma*, while the other treatment plant produced both *Culex* spp. and *Anopheles* spp. We tested application rates of 8 - 10 lbs/ac for these two sites.

As the 2009 season progressed, VectoMax® CG began to emerge as a valuable control tool against both *Anopheles* and *Culex* species found in many sources containing dense vegetation and high organic content. However, an optimal application rate for the winery ponds had yet to be determined, so an intensive examination of one of the winery ponds (Mazzocco Winery) is reviewed in this paper.

MATERIALS AND METHODS

Study Site. Seven treatment locations were evaluated retrospectively; however, for the purpose of this paper, emphasis is going to be placed on one of the winery ponds. Mazzocco Winery in Healdsburg, CA was chosen as the trial site on September 30, 2009. This winery has two ponds measuring 0.25 and 0.125 acres in size. The larger pond was skirted with cattails measuring over 10 ft in height, whereas the smaller pond was clear of any large vegetation. The larger pond typically produces *Culex* larvae, and the smaller pond produces *Anopheles*.

Larval Sampling. At the Mazzocco Winery location, four transects measuring 30 m (100 ft) each were selected and staked with PVC poles. Transect selection was based on high late instar densities, and at each sampling date, a standard 1 pint dipper was used to take 20 dips/transect. Pre-treatment sampling was recorded immediately prior to larvicide application. Post-treatment densities were recorded at two and seven days post-treatment and every seven days thereafter for the duration of the study. The District recorded early instar (L1/L2), late instar (L3/L4) and pupal densities at each sampling date. Live pupae were returned to the laboratory and held for emergence. At all other study site locations compared in this study, a standard 1 pint dipper was used to take a minimum of 10 dips per location. This is consistent with the Districts standard operation procedure for monitoring treatment efficacy of bacterial larvicide products.

Characterization and Transect Setup. Prior to the trial, a Solo backpack sprayer was characterized to ensure an application rate of 20 lbs/ac and a swath width of 30 ft. Five PVC poles were

placed along the bank of the two ponds, each of them spaced 20 ft apart from the adjacent pole. Five gallon buckets were placed on each of the PVC poles to verify the application rate. As stated above, each transect measured 100 ft in length with three transects in the large pond and one transect in the small pond.

VectoMax Application. On the morning of 30 September 2009, after a high density of late instar *Anopheles* spp. and *Culex* spp. were sampled, VectoMax® CG was applied at a rate of 20 lbs/ac to the two ponds. Wind speeds of 0 - 3 MPH were recorded from the NW during the application. An average of 52 granules was counted in each bucket, confirming the desired application rate of 20 lbs/ac. After the granules were counted and recorded from each of the five gallon buckets, the buckets were emptied into their respective ponds.

RESULTS AND DISCUSSION

While each of the seven treatment sites selected for this retrospective study offered unique challenges, one site stood out because the level of control provided was less than anticipated. The District observed control lasting 28 days at sites such as Spring Lake Recreational Area. At this site, an airboat equipped with a solo sprayer applied VectoMax® CG at a rate of 10 lbs/ac to the perimeter of the lake. This site typically produces *Anopheles* spp. however, this year the District saw an unexpected spike in the *Culex* spp. Only one application of VectoMax® CG was required to reduce the populations to acceptable levels. Large scale application of this product was never warranted again at this site. The District is prepared to apply the product again in 2010 should a similar algal decomposition occur.

The District also evaluated two waste water treatment plants each with different levels of vegetation. Application rates of 10 lbs/ac were used at these sites, and control lasted from 15-21 days depending on the level of vegetation (Fig. 1). Treatment plants with less vegetation showed longer control, whereas ponds with greater vegetation showed reduced length of control. The reduction in the length of control could be due to the presence of mosquito refuges.

The four winery ponds chosen for this evaluation varied greatly based on the presence or absence of vegetation. For instance, Jackson Estate had thick vegetation in the middle of the pond making it difficult to treat for mosquitoes. Treatment at this winery was done by boat so an even coverage of the product was possible in the heavy vegetation in the middle of the pond. Other ponds were lined with vegetation along the perimeter, such as Mazzocco Winery and could be treated with a backpack sprayer. Control at these four wineries ranged from 15.0 - 23.5 days depending on the timing of the application. Ponds treated prior to grape crush showed extended control, while those ponds treated during crush had reduced length of control. Mazzocco Winery was treated with VectoMax® CG at a rate of 20 lbs/ac and it was anticipated that control of at least 21-24 days would be seen; however, control was lost by day 14, and a second application had to be made. A detailed evaluation of this treatment was warranted and the following data are related to this study site.

Prior to treatment, the density of late instar larvae along the four transects exceeded the District threshold of 0.1 larvae per dip. Within these transects, late instar larval densities ranged from 0.06 - 1.49 larvae/dip depending on the proximity to the vegetation and the species. A total of five species were collected at the two ponds. Transects nearest to the cattails had more late instar larvae present at the time of the pre-treatment dip counts and a higher density of pupae. The transect located in pond 2 had the greatest density of *Anopheles* larvae, and *Cx. stigmatosoma*, *Cx. thriambus* and *Cx. tarsalis* were the most abundant species collected at these two winery ponds. During the application of the VectoMax® CG, five gallon buckets were placed adjacent to the transect poles to collect granules and verify the application rate. Granules were counted, recorded, and then emptied into the water.

Application of VectoMax® CG achieved >92% control of late instar larvae and pupae and >97% control of early instar larvae at 48 hours post treatment. Within seven days, 100% reduction in L3/L4 larvae was achieved (Fig. 2). A steady recruitment of early instar larvae was identified throughout the study (Fig. 3). While we expected at least 21 days of control based on previous wineries,

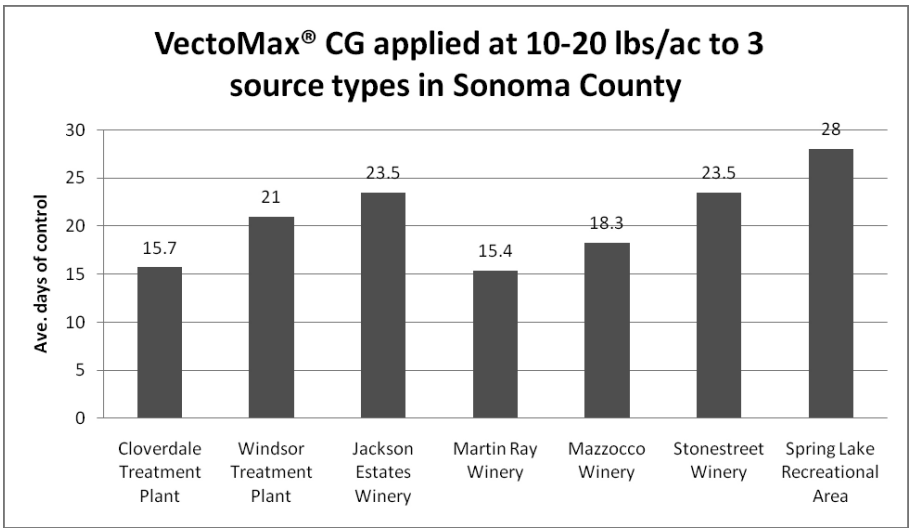

Figure 1. Efficacy of VectoMax® CG at 3 source types in Sonoma County.

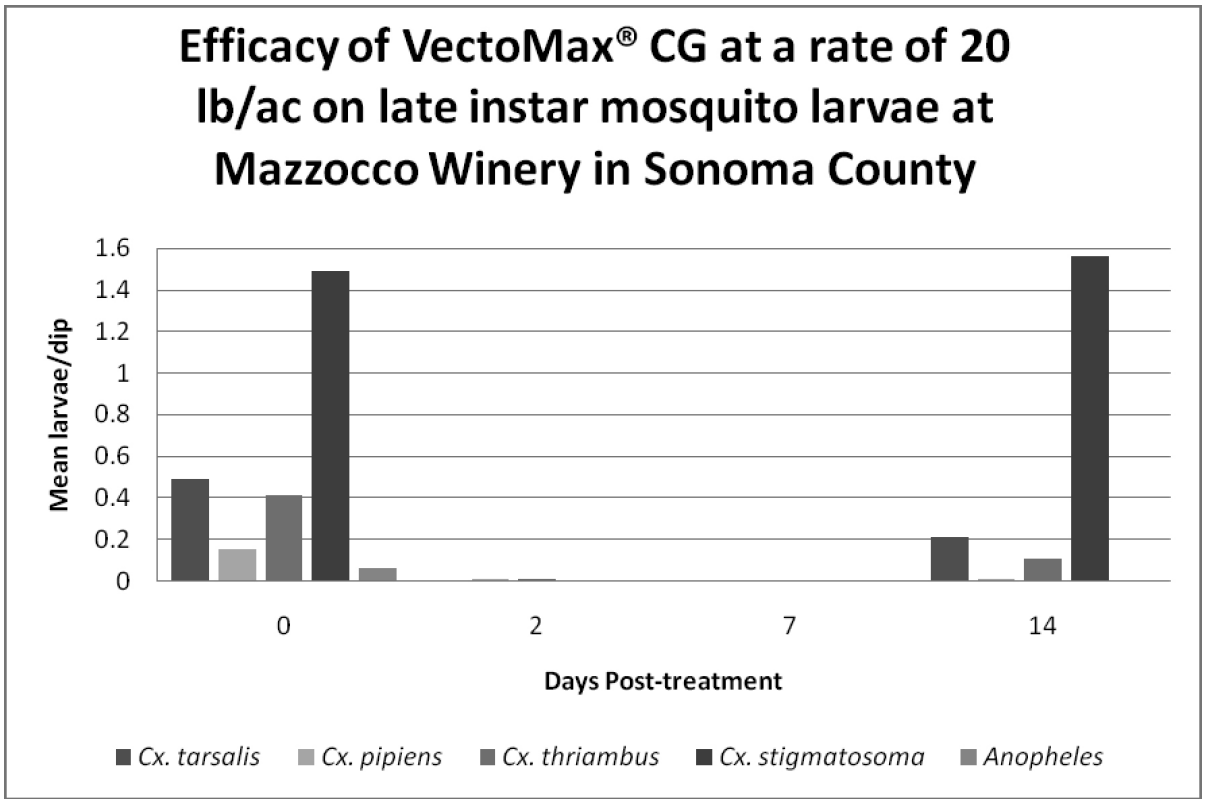

Figure 2. Control of late instar larvae at Mazzocco Winery lasted 14 days when treated with VectoMax® CG at a rate of 20 lbs/ac.

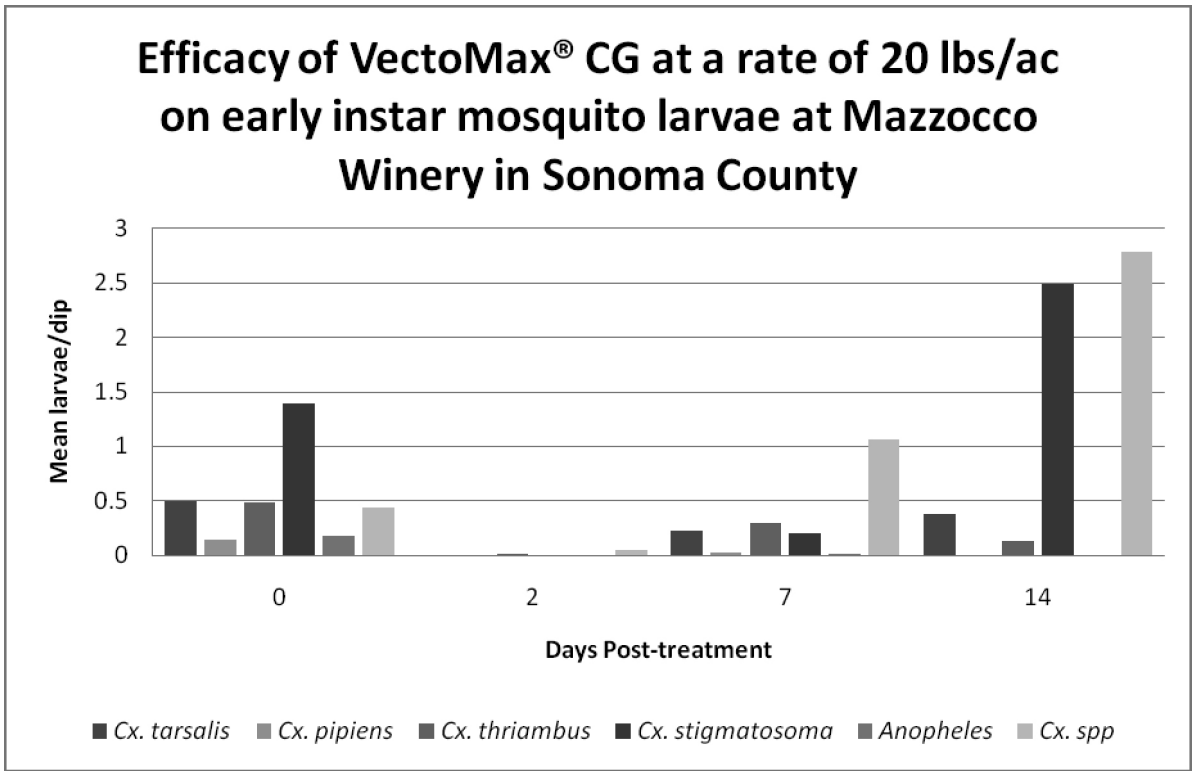

Figure 3. Early instar larvae continued to be recruited to the ponds at Mazzocco Winery.

late instar counts began to exceed treatment thresholds after 14 days. It was determined that another application was needed to control the population. The lack of extended control raised many questions about the efficacy of the product and what could have caused the marked change in the length of control that was normally observed. A laboratory trial was set up to determine if the product lost its efficacy or if something else caused the decline in efficancy. In the lab trial, two buckets were treated with an application rate of 20 lbs/ac. of VectoMax® CG, and two buckets were used as a control. Ten *Culex pipiens* larvae were placed in each bucket daily and the mortality recorded. All pupae were removed from the buckets daily, placed in emergence cages and adult emergence was recorded. Results showed 100% control for over 26 days in both treatment buckets indicating that something else was responsible for control failure in our field study. Further evaluation of the study site showed that during our field experiment water levels were fluctuating daily because of the active grape crush at Mazzocco Winery. Because of this, new water was continuously being added to the ponds and excess water was flushed out and used to water fields. The fluctuation in water depth and the possible removal of product may have influenced the length of control. Due to this discovery, it would be more cost effective for the District to use a less expensive and shorter lived product in the winery ponds during active crush in 2010.

CONCLUSION

Based on 2009 results, the District can effectively control mosquito populations within 48 hours and can observe up to 21 days control using VectoMax® CG at a rate of 10 lbs/ac. This product provides effective control of larvae in winery ponds throughout much of the mosquito season; however, due to multiple factors during crush, more work is needed to determine the cost-effectiveness and efficacy of VectoMax® CG during this critical time in the wine country.

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