Area-wide Management of the Asian Tiger Mosquito
Truck-mounted Larviciding Standard Operating Procedure[1]

Bacillus thuringiensis israelensis (Bti)

Introduction:

The goal of this work was to develop and document a successful method for applying the insecticide *Bacillus thuringiensis israelensis* (Bti) on an area-wide basis to manage larval populations (and ultimately impact adult populations) of *Aedes albopictus* in urban/suburban residential neighborhoods. In our experience this technique provides greater efficacy and longer residual control than the traditional door-to-door interventions employed for *Ae. albopictus*. Door-to-door larval control strategies are hampered by a need for unrealistic manpower resources, limited access to private property, and the inspector's ability to find cryptic or inaccessible (dangerous) larval habitat.

To take into consideration differing availability of low-volume (LV) machines we have optimized the application of Bti for two different machines: the Curtis Dyna-Fog Ag-Mister LV-8™ (Curtis Dyna-Fog, Westfield, IN) and the Buffalo Turbine CSM2 mist sprayer with atomizing spray head (Buffalo Turbine, Springville, NY). Below we give detailed information on the use of both machines with VectoBac® WDG (Valent BioSciences, Libertyville, IL).

NOTE: As a first step in the optimization of these protocols, we performed a comprehensive droplet analysis on a traditional ULV machine, a Buffalo Turbine CSM2 mist sprayer with atomizing spray head, and a Curtis Dyna-Fog Ag-Mister LV-8 low volume sprayer using a 2-D phase doppler particle analyzer (Navy Entomology Center of Excellence, Jacksonville, FL). That information was used to determine optimal equipment settings and droplet profiles. We conducted open field trials with the Buffalo Turbine and LV-8 using the settings determined from the laser tests to evaluate efficacy, swath width, and droplet deposition. These trials provided over 80% mortality out to 300 feet. Given this data, we performed operational trials as part of the control strategy of the ATM project.

[1] Mention of trade names or commercial products in this publication is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the USDA or other involved parties.

NOTE: During the operational trials we performed bioassays to assess both the spray penetration and treatment efficacy by deploying dry open cups in three locations (front, center, and back) of 10 parcels within the treated site. After the application was completed the cups were taken to the laboratory where water and larvae were added and mortality after 48 and 72 hrs was quantified. We will provide detailed protocols for the bioassays upon request.

→ As of 2012 the VectoBac WDG label specifically allows for application using truck mounted LV equipment in urban/suburban areas.

I. Application with Ag-Mister LV-8

Personnel, Equipment, & Materials

Personnel

1. Use two people (driver and navigator) in vehicle with sprayer. This increases safety during the early morning applications.
2. Use one person in a vehicle trailing the sprayer. This vehicle is necessary to keep other vehicles at a safe distance from the spray vehicle.
3. Utilize the same employees to mix WDG and load into the sprayer prior to the application.

LV Sprayer

1. Ag-Mister LV-8™ (Curtis Dyna-Fog, Westfield, IN) orchard sprayer.
    a. Set flow rate to 2.2 gal/min.
    b. Set nozzle pressure to 9 psi.
    The above settings produce droplets with a $Dv_{0.5}$ of107 um.
    c. Position spray boom at a 45° angle from horizontal with four nozzles pointing out on each side of the spray truck.

Vehicle

1. Use a large pickup truck to house the sprayer during applications.
    a. The truck must accommodate the weight of the LV sprayer (500 lbs) plus the 150 gallon spray tank when full.
    b. Drive vehicle at an average speed of 5 mph (8.05 km h^{-1}).
    The approximate speed of the vehicle is calculated based on the number of street miles to be driven so that the correct amount of product is dispensed into the spray block given the 2.2 gal per minute flow rate.
2. Use a second truck to keep other vehicles at a safe distance from the spray vehicle.

Larvicide

1. VectoBac® WDG (Valent BioSciences, Libertyville, IL)
    a. Active ingredient: *Bacillus thuringiensis israelensis*, strain AM 65-52 contains 1.72 lb/gal (205.2 g/l) active ingredient.

Apply at label rates of 400 or 800 grams/hectare. Operational trials at the 800 gm/ha rate showed significantly increased efficacy in field bioassays.

b. Mix WDG at 59 and 118 gm/L of water for the 400 and 800 gm/ha rates respectively.
c. Premix WDG in separate containers (5 gallon pails) before adding to the sprayer tank. This can take several hours of preparation time immediately preceding the spray event. Use drill powered paint mixers to mix the product well but make sure to use plastic paint mixers, as metal mixers were found to damage the mixing buckets resulting in plastic shaving that impeded the flow from the machine during the application. Fill each pail about ¾ with water and add/mix WDG into solution. Several pounds of WDG may be added to each pail until mixed completely. Once mixed with water WDG must be used within a 48-hour period.

Procedure

Application Time

1. Conduct truck-mounted larvicide applications in the early morning between 1:00 and 5:00 a.m., when human activity and vehicle traffic is at a minimum.
2. An application within an urban 120 acre site will take approximately 2 hours for a single truck to complete. Preparation time of material will take approximately 1.5 hours.

Swath & Area

1. Set insecticide flow rates to accommodate a 300 ft (91 m) swath width in suburban treatment areas.
2. In highly urbanized residential areas with dense housing, such as duplexes or row homes, conduct applications from both streets and alleys located within the site. In this case base insecticide flow rates on a swath width of 150 ft (46 m).

Environmental Conditions

1. Perform larvicide applications when convection currents are minimal, ground wind speed is above 1mph and rain is negligible. An application may be performed during light fog or light rain (drizzle) as long as wind speed is above 1mph.

II. Application with Buffalo Turbine CSM2 mist sprayer

Personnel, Equipment, & Materials

Personnel

1. Use two people (driver and navigator) in vehicle with sprayer. This increases safety during the early morning applications and the navigator can change the angle of the spray head from within the truck if necessary.

2. Use one person in a vehicle trailing the sprayer. This vehicle is necessary to keep other vehicles at a safe distance from the spray vehicle.
3. Utilize the same employees to mix WDG and load into the sprayer prior to the application.

LV Sprayer

1. CSM2 Mist Sprayer (Buffalo Turbine, Springville, NY).
    a. Equip the sprayer with a rotary atomizing spray head (available from Buffalo Turbine).
    b. Set flow rate to 2.2 gal/min.
    c. Use the 0.020 screen at 150 psi with air speed set at 110 mph. These settings produce low-volume sized droplets with a $Dv_{0.5}$ of 233 um.
    d. Position spray head at a 60° angle from horizontal pointing in the direction of the swath to be sprayed. The angle of the spray head can be adjusted from inside the cab of the truck with a remote controller.

Vehicle

3. Use a large pickup truck to house the sprayer during applications.
    a. The truck must accommodate the weight of the sprayer (600 lbs) plus the 50 gallon tank when full.
    b. Drive vehicle at a speed of 5–10 mph (8.05 km h^{-1} to 16.1 km h^{1}). The approximate speed of the vehicle is calculated based on the number of street miles to be driven so that the correct amount of product is dispensed into the spray block given the 2.2 gal per minute flow rate.
4. Use a second truck to keep other vehicles at a safe distance from the spray vehicle. Also use this truck to carry premixed WDG into the field to reload the 50 gallon tank during the application. One reload requires ten 5-gallon pails while three reloads requires thirty 5-gallon pails.

Larvicide

1. VectoBac® WDG (Valent BioSciences, Libertyville, IL)
    d. Active ingredient: *Bacillus thuringiensis israelensis*, strain AM 65-52 contains 1.72 lb/gal (205.2 g/l) active ingredient.
    e. Apply at the label rate of 400 or 800 gm/ha.
    f. Mix WDG at 59 and 118 gm/L of water for the 400 and 800 gm/ha rates respectively.
    g. Premix WDG in separate containers (5 gallon pails) before
    h. adding to the sprayer tank. This can take several hours of preparation time immediately preceding the spray event. Premix WDG in separate containers (5 gallon pails) before adding to the sprayer tank. This can take several hours of preparation time immediately preceding the spray event. Use drill powered paint mixers to mix the product well but make sure to use plastic paint mixers, as metal mixers were found to damage the mixing buckets resulting in plastic shaving that impeded the flow from the machine during the application.

Fill each pail about ¾ with water and add/mix WDG into solution. Several pounds of WDG may be added to each pail until mixed completely. Once mixed with water WDG must be used within a 48-hour period.

Use a large funnel to pour the premixed WDG into the small two-inch pipe attached to the 50 gallon tank.

Procedure

Application Time

1. Conduct truck-mounted larvicide applications in the early morning between 1:00 and 5:00 a.m., when human activity and vehicle traffic is at a minimum.
2. An application within a suburban 270-acre site will take approximately 2-4 hours for a single truck to complete.

Swath & Area

1. Assume a 300 ft (91 m) swath width in suburban treatment areas.
2. In highly urbanized residential areas with dense housing, such as duplexes or row homes, conduct applications from both streets and alleys and assume a swath width of 150 ft (46 m).

Increased efficacy in the bioassays was found when both sides of the street were sprayed. There is an increased effort with this approach. Although the application rate does not change per acre, the volume of liquid is doubled. The 50-gallon tank necessitates bringing premixed WDG into the field to refill the machine. For a roughly 270-acre spray block this increased the volume from 98 gallons (1 refill) to 198 gallons (3 refills) and more than doubled the time to make the application.

Environmental Conditions

1. Perform larvicide applications when convection currents are minimal. An application may be performed during light fog or light rain (drizzle). The ability of the Buffalo Turbine to push the product negates the need for wind to move the droplets and in some instances opposing natural wind directions could be a detriment to the directed spray.