EVALUATION OF DELTAMETHRIN BARRIER TREATMENT BY THE CENTRAL MASSACHUSETTS MOSQUITO CONTROL PROJECT

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ABSTRACT

To evaluate the effectiveness of the residual synthetic pyrethroid SUPSPEND® SC (deltamethrin), the Central Massachusetts Mosquito Control Project (CMMCP) conducted a field trial in the summer of 2008 by using it to treat the foliage around a local recreational field. Surveillance traps were placed in the treatment area of the field as well as at a nearby control site of similar characteristics. Collections were made at both sites starting five weeks before the initial application and ending five weeks after the final treatment. Results show that overall, 74.31% control was achieved and continued for six weeks until surveillance ceased, due in part to cold evening temperatures which was contributing to overall low collection numbers for both sites. With experience gained in these initial trials, CMMCP plans to further evaluate this product as a barrier treatment in the upcoming seasons, with the hope of obtaining another valuable tool for the suppression of high mosquito populations and potential vectors in arbovirus situations.

INTRODUCTION

The use of barrier treatments involving insecticides with residual properties has been used in the past by control agencies to combat disease vectors and reduce high populations of mosquitoes. Barrier treatments are used to reduce the number of mosquitoes from entering areas where people typical gather such as sleeping domiciles or recreation sites by applying the insecticide onto surfaces where mosquitoes would likely have to come in contact with (Cilek 2006). These surfaces could include the inside and outside walls of a residence, a bed net, or the foliage around a recreational field for example (Anderson 1991, Frances 2007, Matthews 2007).

Many synthetic pyrethroids have little residual properties, while deltamethrin has been shown to persist for several weeks (Cilek 2006, Wu 1991). The formulation used, SUSPEND® SC (Bayer Environmental Science, Montvale, NJ) (EPA Reg. No. 432-763), is composed of 4.75% deltamethrin, 0.42lbs AI/gal. SUSPEND® SC is a suspension concentrate in which the active ingredient is in crystal form, producing a more stable product against the impacts of precipitation and sunlight. In the case of foliar treatments, eventual control loss has been attributed to the natural breakdown of the product as well as the formation of new, untreated plant

growth for mosquito resting habitat (Cilek 2006).

For ultra-low volume (ULV) adulticiding there are several factors that can impact efficacy, including foliage and other barriers, droplet size, and time of application (Mount 1998, Reddy 2006). Many of these issues do not generally apply to barrier treatments. Because barrier treatments work by treating contact surfaces for mosquitoes and not necessarily the mosquitoes directly, foliage and other barriers are actually the medium for the application, not an obstruction as with ULV applications. Droplet size, as it relates to transport during drift, does not apply in barrier treatments because the application is designed to stay on the resting site medium, and not drift through active mosquito areas (Cilek 2006). Application time is not a vital a factor for barrier treatments because host-seeking mosquitoes are not required to be present for successful control as with ULV applications (Mount 1998).

With interest for possible barrier treatments at CMMCP, field trials with SUSPEND® SC were conducted in the summer of 2008.

METHODS

A local collection of recreational fields was selected as the site for this project based primarily on layout and dense barrier foliage, ideal for this type of application. The treatment and control sites were on separate fields towards the opposite ends of the complex. Once established, pre-application surveillance began at the two sites using model 512 CDC miniature light traps baited with CO_2 (500ml/min), along with model 1512 collection bottle rotators (John W. Hock Co., Gainesville, FL). These traps were place in the recreational field away from the foliage so that in order for the host-seeking mosquitoes to reach the traps, they would have to travel through the treated foliage.

The applications were made by a modified LECO ULV Model HD[1], which supplied a flow rate of approximately 1gal/min with a subsequent increased droplet size over a standard ULV sprayer. The SUSPEND® SC was diluted in water to 1oz/gal. This dilution rate of 1oz/gal is the middle of the labeled range. A visual inspection was made of the foliage following the treatments to observe the absence or presence of product. Several modifications were made to the application protocol for the second application due to a perceived lack of control. In the first application, a vehicle speed of 8-10mph was used, but was lowered to 5mph for the second application. We also moved the vehicle from 4-6ft away from the foliage barrier in the first application to 10ft in the second one. In addition to removing the shear ring to achieve coarser droplets, the spray head angle for the second application was lowered approximately 10-15° and positioned perpendicular to the foliage medium.

Weekly collections were made at both sites prior to the initial application for five weeks. In the

[1]Pictures and schematics are available by calling the CMMCP office at (508) 393-3055.

days following this initial application, two collections were made, with results prompting the consideration and implementation of a second barrier treatment. Following the second application, seven more collections were made over the course of five weeks. Mosquito collections were labeled by site and date, and stored for later identification by morphology (Andreadis 2005). The collection means for both the control and treatment sites were computed and graphed according to their relationship to the barrier treatments. The individual collections were also graphed for both sites with the application events noted.

RESULTS

Pre-treatment surveillance consisted of weekly collections over 5 weeks, and showed substantial mean mosquito levels at both the control site and the treatment sites (approximately 134 and 204 respectively). After the initial application, both sites saw drops in average collections. However, following the second application, the treatment site had a decrease of 87.29% compared to the collection period after the initial application, while the control site actually observed an increase of 1.40% during this period (Figures 1, 2). Comparing the pre-treatment surveillance levels to those following the second application, the treatment site had an 89.8% mean reduction. Overall, following the initial application to the end of surveillance, there was a 74.31% drop in average collections at the treatment site compared to the pre-application surveillance there (Figures 3, 4).

Figure 1: Trap Site Collection Means (%Δ From Previous Collection Period)

	Pre-Application 1	A1-A2	Post-Application 2
Control Site	133.80	92.00(-31.24%)	93.29(+1.40%)
Treatment Site	203.60	163.00(-19.94%)	20.71(-87.29%)

Figure 2: Comparison of Trap Site Collection Means

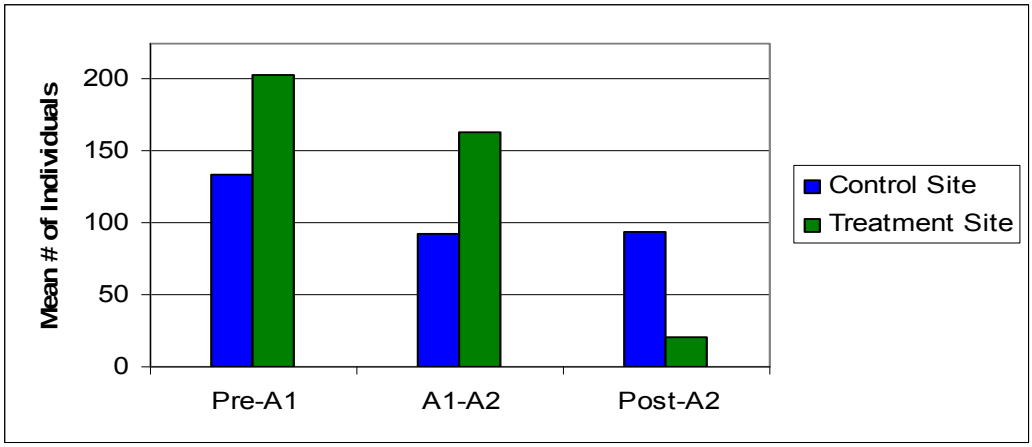


Figure 3: Comparison of Weekly Collections for Project Sites

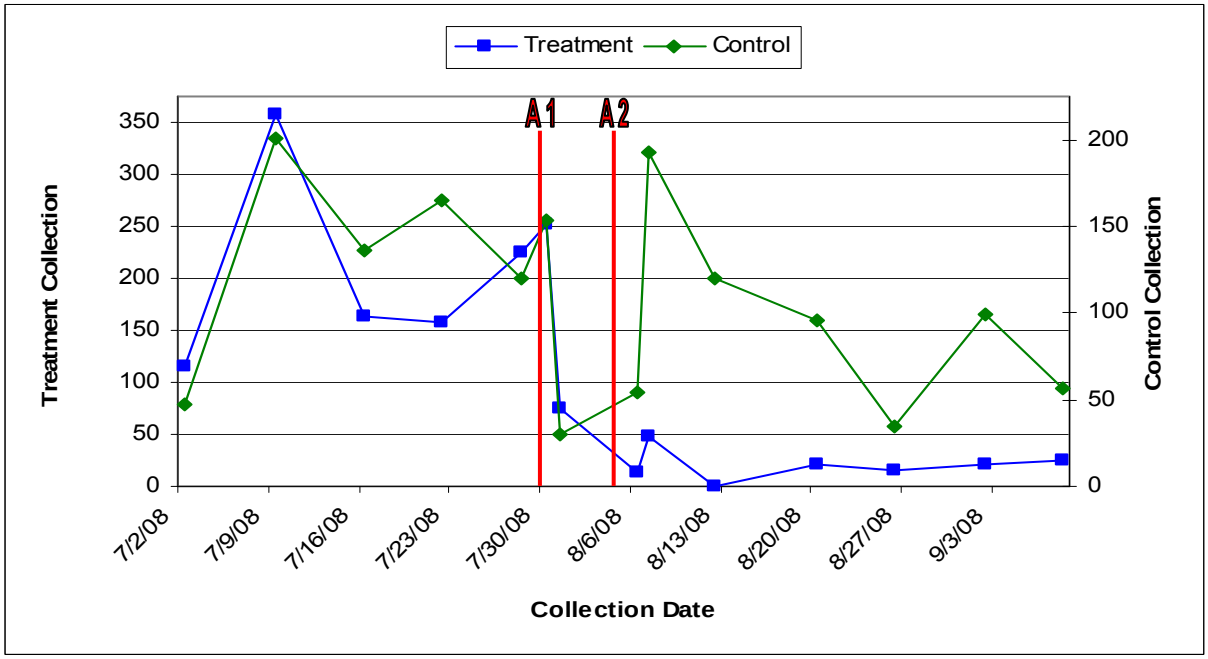
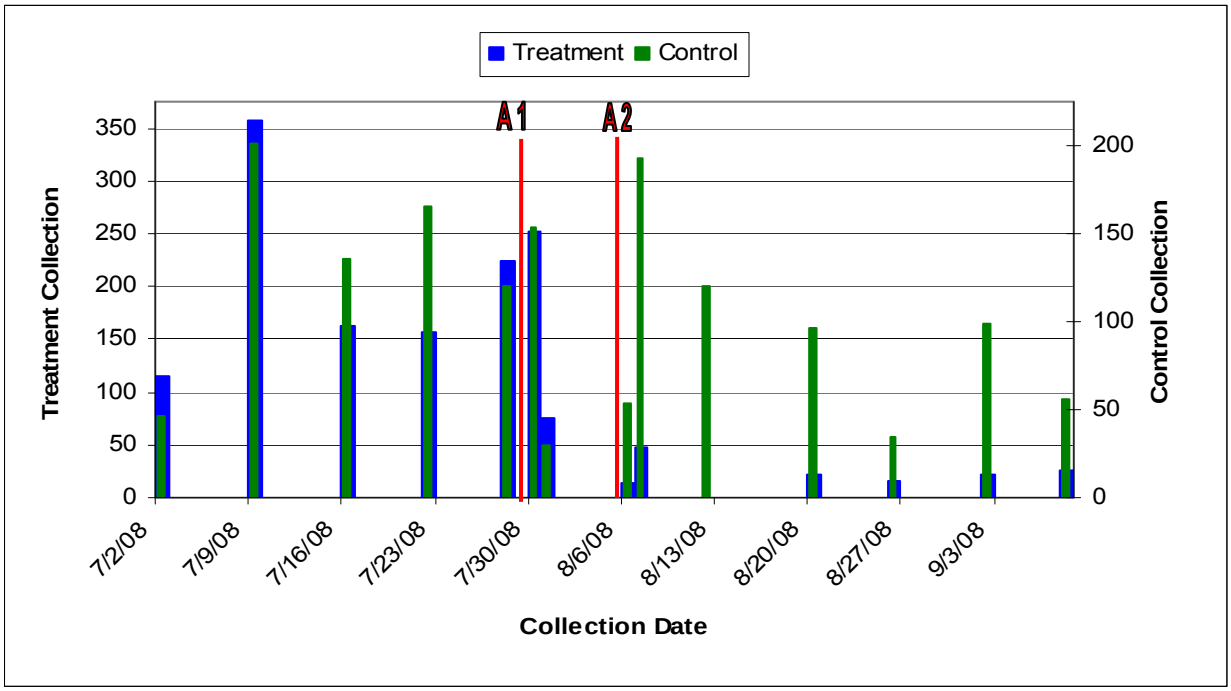


Figure 4: Comparison of Weekly Collections for Project Sites (2)



DISCUSSION

Surveillance showed that control was achieved following both applications, although the initial application was not perceived to have been as effective as it potentially could have been, therefore necessitating a review of the equipment and prompting a second application. One potential cause discussed was that the spray head was not at an angle that was conducive for applying coverage to the lower half of the foliage around the field. With the spray angle too high, the application was possibly missing the lowest couple of feet, which may have influenced the collections. With the spray head angle adjusted, spray head nozzle modifications, decreased vehicle speeds, and increased distance from application medium, the second application showed significantly more control than the first, while the control site actually saw an increase in the average collection numbers following the second application. This decrease for the treatment site lasted until collections ended, but may have also been influenced by lowering evening temperatures. New untreated plant growth and the natural breakdown of the deltamethrin would have been cause for an increase in collection numbers. Trials in the future will be conducted with the second treatment protocol.

Although sustained control can be achieved from the use of barrier treatments using products such as SUSPEND® SC, we will not be using this product exclusively, but in conjunction with all other elements of a successful IPM program. The CMMCP use of a mid-level dilution rate lowered the potential for impact to non-target species, while still achieving the control observed. These promising observations will lead CMMCP to further evaluate SUSPEND® SC as a situational tool in the suppression of high mosquito populations and the control of vector-borne diseases such as West Nile virus and Eastern Encephalitis.

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