FINAL REPORT

SPONSOR: Department of Agriculture & Consumer Services
Bureau of Entomology and Pest Control
State of Florida
1203 Governors Square Blvd.
Suite 300, Magnolia Center 1
Tallahassee, FL 32301-2994

CONTACT PERSON: James Clauson, Environmental Manager
Tel: 850-922-7011
Email:clausoj@doacs.state.fl.us

PRIMARY
INVESTIGATOR: James E. Cilek, Ph.D., Professor
Mulrennan Public Health Entomology Res. & Ed. Ctr.
Florida A & M University
4000 Frankford Avenue
Panama City, FL 32405
Tel: 850-872-4184 x27
Email: james.cilek@famu.edu

TITLE OF PROJECT: Evaluation of Automatic Spray Systems for the Control of Backyard Mosquitoes (DACS 012017, FAMU 0010701)

DATE OF REPORT: November 29, 2007

INTRODUCTION

Automatic-timed insecticide mist application systems, for the purpose of controlling mosquitoes in residential backyards, are becoming more common in the market place. Recently, the Florida mosquito control community has questioned the effectiveness of such systems. This study was funded to determine the efficacy of these application systems to control adult mosquitoes in Florida residential backyards compared with backyards without such systems.

PLAN OF RESEARCH

Residential Field Study

This study used MistAway® automatic misting systems (Manufacturer: MistAway, Houston, TX) professionally installed by a licensed/certified pest control operator (Arrow Pest Service, Panama City, FL) in three northwest Florida backyards (averaging approximately 55 ft deep x 85 ft wide). Each treatment backyard was paired with an untreated (control) yard no closer than 100 ft away for comparison purposes. Two of the treatment/control backyards were located in Bay County and

one backyard/control was located in south Walton County, Florida. Study sites were approx.20 miles from one another.

The MistAway automatic misting system is a closed loop system that consisted of a series of Hago® nozzles placed at 10 ft intervals along the inner perimeter of a yard. Nozzles were connected by a plastic line to a 55-gal water reservoir containing synergized pyrethrins concentrate (Summerfrost®) formulated as a 3% AI pyrethrins, 6% AI piperonyl butoxide, and 10% AI n-octyl bicycloheptene dicarboximide mixture (the latter two compounds are synergists). According to the manufacturer, the nozzles delivered 41 ml/min per nozzle at 180 psi. The number of nozzles in treatment backyards ranged from 26-43, placed 3-4 ft above ground surface. The spray unit contained a programmable display panel that controlled the frequency and duration of spray application. All systems were set to deliver a 45 sec spray (containing 0.05% AI) at dawn and another application at dusk. The display panel could also be accessed to determine if the homeowner had overridden the system for additional sprays. No additional applications were noted at each treatment site.

The spray droplet spectrum of the Hago nozzles was determined by Dr. Jonathan Hornby (Lee Co. Mosquito Control District) using the District's spray tunnel and a Malvern laser. Droplet spectrum of spray nozzles was as follows: Dv 0.1=13µm, Dv 0.5=35µm, Dv 0.9=74µm.

In the original study protocol, mosquito landing rate counts were to be used as the method of evaluating mosquito abundance in control and treatment yards. This method proved to be unreliable and was abandoned in favor of using 6v battery operated ABC suction traps, with the light on, baited with carbon dioxide from a 20-lb pressurized cylinder at a release rate of 500 ml/min. 24 h collections were obtained twice a week and trap collections identified to species. The 35-week study started on March 22 and continued through November 16, 2007. The study was ended in November due to the onset of cooler weather. Because there were no definitive trend differences between mosquito species in control or treatment backyards, results are reported as pooled species.

Simulated Backyard Study

Wire Cage Bioassays

To assess efficacy of the insecticide when applied via the misting system, a simulated backyard (50 ft deep x 75 ft wide) was constructed on the grounds of the Mulrennan Public Health Entomology Res. & Ed. Ctr., Panama City. The backyard was framed by a 4 ft. PVC pipe perimeter "fence" in an open "U" shape arrangement. A MistAway® automatic misting system was professionally installed by Arrow Pest Service in August 2007. Eighteen Hago nozzles spaced 10 ft. apart were positoned on the top inner edge of the fence with the appropriate rubber tubing. Nozzles were oriented at approx. 45°. A single line of 3-gal potted wax myrtle plants ((*Myrica*

certifiera) was placed along the inside perimeter of the PVC fence (total 85 plants) to simulate the vegetative border of a suburban backyard. Plants were approximately 6 inches below the spray nozzles.

Wire cage mosquito bioassays were used to determine efficacy of the insecticide application. Cages were placed approximately 5 ft from ground surface on wooden stakes arranged in a grid starting 10 ft away from the nozzles. Laboratory-reared 5-7 day-old adult *Aedes albopictus* and *Culex quinquefasciatus* were used in evaluations. Tests were repeated on three different calendar dates with each species in a separate cage but tested at the same time. Tests were conducted at dusk. After ten minutes had elapsed after application (to allow the spray cloud to pass through the backyard) cages were removed from the treatment area. At this time the mosquitoes were removed from the cages by lightly knocking them down with carbon dioxide then placed in clean 1 pt paper containers and covered with fine screen cloth. A cotton ball soaked in 10% sugar water was placed on the top of each container. Knockdown/mortality was assessed at 24 hr.

Excised leaf bioassays

Potted wax myrtle plants ((*Myrica certifiera*), previously placed along the front perimeter of the PVC fence, were used in these bioassays. Plants were approximately 6 inches below the spray nozzles. Excised leaf bioassays were performed about 30 minutes after a spray application by removing 2 adjacent leaves from the top canopy of 4-7 plants in the immediate vicinity of the nozzles. Single leaves were placed in individual screened 250 ml glass beakers. At least 15 adult *Ae. albopictus* and *Cx. quinquefasciatus* were mouth aspirated into separate beakers. A cotton ball soaked in 10% sugar water was placed on the top of each container. Knockdown/mortality was assessed at 24 hr. Tests were repeated on 7 calendar dates and both species were tested at the same time.

Preliminary results indicated that knockdown/mortality from residual deposits on leaves were often <50% and highly variable. To determine if the data were confounded because of leaf geometry, wax cuticle, or other features of the leaves 2 filter paper "leaf" bioassays were conducted on different calendar dates using the methods stated earlier. Filter paper (Fisher Brand qualitative 9.0 cm diam) "leaves" were cut to the approximate mean size of leaves used in the excised leaf bioassays (surface area approximately 1.5 sq. inches). Two filter paper leaves were carefully attached together, with a paper clip at their base, to terminal parts of plants (filter papers were oriented vertically) about 12 inches from the spray nozzles then treated as stated earlier in the excised leaf bioassay. Two wax myrtle leaves were also sampled in the immediate area after application as a comparison. Knockdown/mortality was assessed at 24 hr.

Results

Residential Field Study

During the 35 week study 16 mosquito species were collected; the 4 major pest species were, in decreasing abundance: *Ochlerotatus taeniorhynchus*, *Culex erraticus, Anopheles crucians, and Cx. salinarius.*

Because the Florida Panhandle experienced drought conditions during most of the summer of 2007 weekly mosquito abundance in control and treatment yards will be broken up into 3 periods for easy comprehension of the field data, i.e. week 1-5 (March 22-April 19) is the period before the drought, week 6-27 (April 24-September 21) is the period during drought conditions, week 28-35 (September 25-November 16) is the period after the drought where substantial rainfall started to occur and mosquito populations started to rebound. Moreover, Florida Statute 5E-13 states that when 25, or more, mosquitoes are collected in a trap per night that it justifies the application of an adulticide. It is this threshold that the data from treatment and control yards in this study will also be compared to.

During the first 4 weeks of the study, the average mosquito reduction in treatment yards ranged from 98-48% (Figure 1). Mosquito populations were starting to naturally decline and on the 5th week. Trap collections that week revealed no difference between treatments and controls. Populations in the treated yards were well below the threshold for this 5 week period.

Due to drought conditions during most of the summer, mosquito populations remained, for the most part, below the State action threshold in control and treatment areas (Figure 2). Reduction of mosquitoes in treated yards ranged from 74-14%, however, there were 4 weeks where there was no difference in the number of mosquitoes between control and treatment traps. Mosquito abundance in treatment yards was below the action threshold for 20 of 22 weeks, while abundance in control yards was below the threshold for 19 weeks. I should also note that one of the cooperators dropped out of the study on July 16 leaving us with 2 treatment yards and 2 control yards for the remainder of the study. Consistent and substantial rainfall started again in late September (week 32) with concomitant increases in mosquito abundance. After that time the misting system reduced mosquitoes in treatment yards below the action threshold for 5 out of 8 weeks while mosquito reduction ranged from 91-48% (Figure 3).

Simulated Backyard Study

Wire Cage Bioassays

Both mosquito species generally responded similarly when exposed to the synergized pyrethrins mixture in the cage bioassays, therefore the results presented here will combine both species. The level of efficacy of the insecticide application on caged mosquitoes was influenced by distance from the nozzle, i.e. mosquitoes farther from the nozzle exhibited less knockdown/mortality than mosquitoes closer to the nozzle (Figure 4). Knockdown/mortality dropped off considerably after 20 ft and

was probably influenced by the larger droplet spectrum (i.e. Dv 0.5=35µm) compared with a Dv 0.5 of 15 µm for aerosols generated by ground ULV applications.

Excised leaf bioassays

Mean percent knockdown/mortality of *Ae. albopictus* in the treated leaf bioassays was greater (22.3% ± 4.5%) than *Cx. quinquefasciatus* (9.7% ± 3.7%) and showed that very little residual existed on plants as a result of the synergized pyrethrin application. Comparable data were obtained with similarly treated filter paper bioassays (i.e. *Ae. albopictus* 43.5% ± 12.3%; *Cx. quinquefasciatus* 26.4% ± 10.9%).

Conclusion

The MistAway system reduced backyard mosquitoes from 98-14% during a 35 week evaluation study in northwestern Florida. Primarily, mosquito reduction in backyards with the mist system was achieved by the direct exposure of the mosquitoes to the spray application. Although some residual toxicity may occur to mosquitoes resting on leaves exposed to the spray droplets, it was not the main method of reduction. During the study, there were only 5 sample weeks where mosquito abundance in treatment yards proved to be no different than untreated yards. Due to lack of rainfall in the summer, mosquito populations remained below the State of Florida 5E-13 action threshold for adulticiding. In early fall, (the last 8 weeks of the study) mosquito populations later rebounded as a result of increased precipitation; during that time the MistAway system maintained population levels below the State threshold for 5 for those weeks where reduction ranged from 91-48%.