

A COMPARISON OF MOSQUITO CATCHES WITH CDC LIGHT TRAPS AND CO₂-BAITED TRAPS IN THE REPUBLIC OF VIETNAM¹

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INTRODUCTION. One of the roles of preventive medicine personnel in the Republic of Vietnam is to conduct mosquito surveys for the determination of disease vectors and their distribution and seasonal variations, and the effect of control measures. Light traps produced the most useful quantitative data for comparisons of relative mosquito abundance in an area. Two models of traps have gained general acceptance for sampling mosquito populations. The New Jersey light trap is used in permanent installations where power sources are available. The CDC light trap, powered by storage batteries, is used in more remote and isolated areas. However, CDC light traps placed in the field have proved unsatisfactory for field surveys. Mosquito surveys conducted at Long Binh, Vietnam, during the summer of 1971 have consistently produced catches too small for evaluation.

Tests were undertaken to determine if the use of dry ice (CO₂) would improve the efficiency of these traps. The use of carbon dioxide as an attractant in light traps to determine adult mosquito populations has been previously studied by many investigators. Carestia and Savage (1967) demonstrated increased activity and feeding response of mosquitoes when they are exposed to carbon dioxide gas. Miller *et al.* (1969) reported the total mean catch

in CDC traps baited solely with CO₂ was increased 30-fold, and the traps baited with CO₂ plus light yielded better than a 100-fold increase. Stryker and Young (1970) attempted to ascertain the effectiveness of carbon dioxide and L (+) lactic acid as attractants when used in various levels and combinations under field conditions. The authors observed that the number of species of mosquitoes was doubled in traps utilizing carbon dioxide gas as compared to light alone.

MATERIALS AND METHODS. The standard CDC light trap was modified for this study. The standard collapsible collecting bag was replaced with a screen cylinder 12 inches long. A killing jar containing DDVP (2½ x 2½ piece of Vapona Pest Strip) was attached to the lower end of the trap cylinder. A perforated paper cup was suspended above the DDVP in the killing jar to contain the killed specimens. The killing jar prevented escape of mosquitoes in the event of motor failure. The fans, operating on all traps, were powered by 6 volt DC lead batteries. Fresh batteries were used for each night's trapping. Each trap was suspended 3 feet off the ground from a triangular wooden structure.

Nine traps were used for each night's trapping; three containing a CO₂ source (dry ice), three containing light in addition to CO₂ and three operated with only light. Traps were placed 25 meters apart in a pattern consisting of three rows of three traps each. A schedule was designed to rotate the treatments at each site nightly. The trap sites were in a field adjacent to a used auto tire storage area.

Each CO₂ trap was baited with 4-5 lbs of dry ice. The dry ice was wrapped in a perforated plastic bag and placed

¹Mention of a proprietary product does not imply endorsement by the U.S. Army. The opinions contained herein are those of the authors and should not be construed as official or reflecting the views of the Department of the Army.

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on the lids of the light traps each evening. Trap collections were made each night between 1900 and 0730 hours. Each morning the traps were collected and the mosquitoes removed from the killing jar and identified.

RESULTS. Table 1 contains a compilation of the data on 23 species collected during the study and their respective percentages of the total population. A total of 4,551 adult mosquitoes were collected during the study. The traps operating with light and CO₂ collected an average of 161.1 adults per trap night. The traps operating with CO₂ collected an average of 297 adults per trap night, and the standard CDC trap operating with a light source collected an average of 6.3 adults per trap night.

A total of 23 mosquito species were collected; however, only 11 of these were represented in the catches of the standard CDC light trap.

The *Culex* species were attracted in the greatest numbers. *Culex tritaeniorhynchus* represented 35 percent (1,517) of the total specimens captured in this study.

All the CDC traps baited with carbon dioxide attracted greater numbers of *Culex* mosquitoes than unbaited traps, with the exception of *Culex whitmorei*. Fifty-seven percent of the *Culex whitmorei* catch was in the trap containing both CO₂ and a light source. Seventy-nine percent of the *Culex pipiens quinquefasciatus* mosquitoes were captured in the traps baited with only a CO₂ source. Only 7 percent were captured in the traps baited with CO₂ plus light, while over 13 percent were in the standard CDC trap.

Seven *Anopheles* species were collected during the study. *Anopheles peditaeniatus* were collected in the greatest numbers. The total collection of this species was evenly divided between the CO₂ traps and the traps with light and CO₂. The total collection of *Anopheles indiensis*, *Anopheles ramsayi*, and *Anopheles vagus* were in those traps baited with only a CO₂ source. One *Anopheles tessellatus* was collected in the CO₂-light trap and one *Anopheles annulans* was collected in the CO₂ baited trap. Of the

TABLE 1.—Adult mosquitoes caught by modified CDC light traps on 27 trap nights.

Species	Total # collected	% Collected CO ₂ & light	% Collected CO ₂ only	% Collected light only
<i>Anopheles indiensis</i>	15	0.0	100.0	0.0
<i>A. peditaeniatus</i>	72	51.4	48.6	0.0
<i>A. tessellatus</i>	1	100.0	0.0	0.0
<i>A. annularis</i>	1	0.0	100.0	0.0
<i>A. jamesii</i>	3	33.3	66.7	0.0
<i>A. ramsayi</i>	3	0.0	100.0	0.0
<i>A. vagus</i>	9	0.0	100.0	0.0
<i>Aedes albopictus</i>	92	17.4	77.2	5.4
<i>A. lineatopennis</i>	2	50.0	50.0	0.0
<i>Coquillettidia crassipes</i>	2	50.0	50.0	0.0
<i>Culex annulus</i>	325	38.2	56.6	5.2
<i>C. gelidus</i>	343	34.7	63.3	2.0
<i>C. nigropunctatus</i>	2	50.0	50.0	0.0
<i>C. pallidothorax</i>	115	44.3	53.0	2.7
<i>C. pipiens q.</i>	29	6.9	79.3	13.8
<i>C. pseudovishnui</i>	156	11.5	87.9	0.6
<i>C. sitiens</i>	768	32.3	67.4	0.3
<i>C. tritaeniorhynchus</i>	1,517	25.2	73.1	1.7
<i>C. whitei</i>	285	32.6	65.3	2.1
<i>C. whitmorei</i>	263	57.4	42.2	0.4
<i>Mansonia annulifera</i>	1	0.0	100.0	0.0
<i>M. dives</i>	35	20.0	80.0	0.0
<i>M. uniformis</i>	383	41.5	57.2	1.3

total number of *Anopheles* species collected, 69 percent were *Anopheles ped-taeniatus*. Fifteen *Anopheles indiensis* were collected, all of which were in the CO₂ traps.

Only two species of *Aedes* were collected. Ninety-two *Aedes albopictus* adults were collected representing 2 percent of the total adult catch. Seventy-seven percent of the *Aedes albopictus* were collected in the CO₂ traps. *Aedes albopictus* were not collected in large numbers even though there were high populations breeding in the tires in the area. Large numbers of adults and larvae were observed by investigators in an area adjacent to the light trap test site. *Aedes albopictus* adults, being primarily daytime biters, were not attracted to the test treatments.

Three *Mansonia* species were collected during the trapping period. The largest collection was *Mansonia uniformis* (383). Of this total, 41 percent were collected in the traps containing light-CO₂ and 57 percent were collected in the CO₂ traps. Eighty percent of the *Mansonia dives* were collected in the CO₂ baited traps. One *Mansonia annulifera* adult was collected in a CO₂ baited trap.

The results indicate that the CDC light trap baited with CO₂ plus light, or CO₂ alone, represent a useful tool for mosquito surveillance. The use of CO₂ without light was superior to the other two treatments with few exceptions. Traps in which the lights were removed had definite advantages especially in hostile military environments where existing condi-

tions precluded the use of light after dark.

The quantity of dry ice used per trap was more than adequate. Ice was still present in the mornings when the traps were collected. We had no way to regulate the flow rate of CO₂ but based on figures reported by Morris and Defoliart (1969), the release rate was comparable to that of a large mammal.

SUMMARY. The total number of mosquitoes trapped in the CDC light traps was significantly increased by the use of carbon dioxide. Eleven species of mosquitoes were collected in unbaited light traps while 23 species were collected in the baited traps. Apparently, many species were attracted to the CO₂ baited traps that normally would not have been collected in the standard CDC light trap. Results indicate that CDC miniature light traps baited with CO₂ alone represented a much more useful tool for sampling mosquito populations.

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