COLLECTING OVIGEROUS *CULEX PIPIENS QUINQUEFASCIATUS* SAY NEAR FAVORABLE RESTING SITES WITH LOUVERED TRAPS BAITED WITH INFUSIONS OF ALFALFA PELLETS

LEYBURN F. LEWIS, TRUMAN B. CLARK, JAMES J. O'GRADY AND DARRELL M. CHRISTENSON

Western Insects Affecting Man and Animals Laboratory, Agricultural Research Service, U. S. Department of Agriculture, Fresno, Calif. 93727

ABSTRACT. Ovigerous *Culex pipiens quinquefasciatus* Say females readily entered traps baited with an infusion made with 8 gm of alfalfa pellets per liter of water. Traps with screen wire louvers caught more mosquitoes than traps with other types of entrances. Louvers with a projecting, upward-curving bottom screen retained a higher percentage of entering females than louvers with unhooded entrances. At one suburban home, 3653 mosquitoes were caught in 106 nights for an average of 16.6 females per trap night.

Organically rich water in assorted types and sizes of containers, catch basins, or sumps is attractive to ovigerous females of *Culex pipiens quinquefasciatus* Say, a fact well-known to most who work with mosquitoes (Barr 1960, 1967; Evans & Fink 1961; Lewis and Christenson 1973; Patterson *et al.* 1970). The urge that impels *C. p. quinquefasciatus* to seek, by choice, such ovipositional sites is, of course, grounded in its cryptive nature. However, the extreme degree of its cryptiveness was only revealed to us in 1972 in Fresno, California. There, over a 30-day period, females deposited 252 egg masses on an alfalfa pellet infusion in a small Styrofoam® ice chest whose sole avenue of ingress was downward through a 5½ x 8½-inch grid with openings ½ x ½-inches square by 3½ inches deep. Over the same 30-day period, an average of only 176 masses were deposited in 2 abutting, open chests even though the 3 were periodically rotated and reprovisioned with equal aliquots of the same infusion.

When the described oviposition occurred, we hypothesized that such strong cryptive propensities could be exploited to trap the females in considerable numbers. A factor that added weight to the desirability of a trap for ovigerous females had occurred almost nightly in the parking lot at the rear of our laboratory where egg masses in considerable numbers were deposited in large rearing receptacles unless they were screened, but the simultaneous catch of females was negligible in a nearby New Jersey-type light trap. Obviously, the egg-laying population on those nights exceeded greatly the catch of the light trap.

Some of our efforts to obtain an explanation of these incidents constitute the subject matter of this paper.

MATERIALS AND METHODS. In our work with *C. p. quinquefasciatus*, the ovipositional medium has proved to be the primary key to success, and a satisfactory attractant has been found to consist of approximately 8 grams of alfalfa pellets per liter of water in a screen-lidded tank in full or partial sunlight (Fig. 1A). In the hot summers at Fresno, the mixture approached its peak attractiveness in about 3 days and then declined in effectiveness unless additional pellets were added; in the cooler months, though, the infusion should be matured at or slightly above room temperature. In practice, during the summer we set up a tank on Friday and added pellets to it again on Monday; we also added pellets to any aliquot when it was transferred to a trap. The alfalfa pellets we used were pressed so densely that they tended to sink when placed in water, but when they became wet, they swelled and trapped gases, which caused those that retained some cohesiveness to float while those that disintegrated remained or became submerged. We had some evidence

that infusions with floating alfalfa pellets were more attractive than those composed wholly of submerged pellets. Thus since agitation or pouring caused the floating material to disintegrate into discrete particles and sink, we considered it important to add a fresh supply of pellets to any aliquot of an infusion when it was placed in a trap if it had been hauled around, poured, or for any other reason contained no floating material. In the cooler months we used various perforated but floating devices to maintain pellets at or slightly above the surface of the media.

Also, since oviposition actually occurred in our traps, we routinely flushed them out and changed infusions every 7 days to avoid emergence in the traps.

We have used several types of louvered traps successfully. As a rule, in a given location, a trap with a large volume of infusion caught more females than a trap with a smaller volume. In addition, traps with the louvers extending over and immediately above the infusions generally yielded higher catches than traps with the louvers further removed from the infusions. This cryptic species was not only adept in seeking means of ingress, it was equally proficient in locating avenues of egress, probably through an ability to sense and then follow or backtrack on even mi-

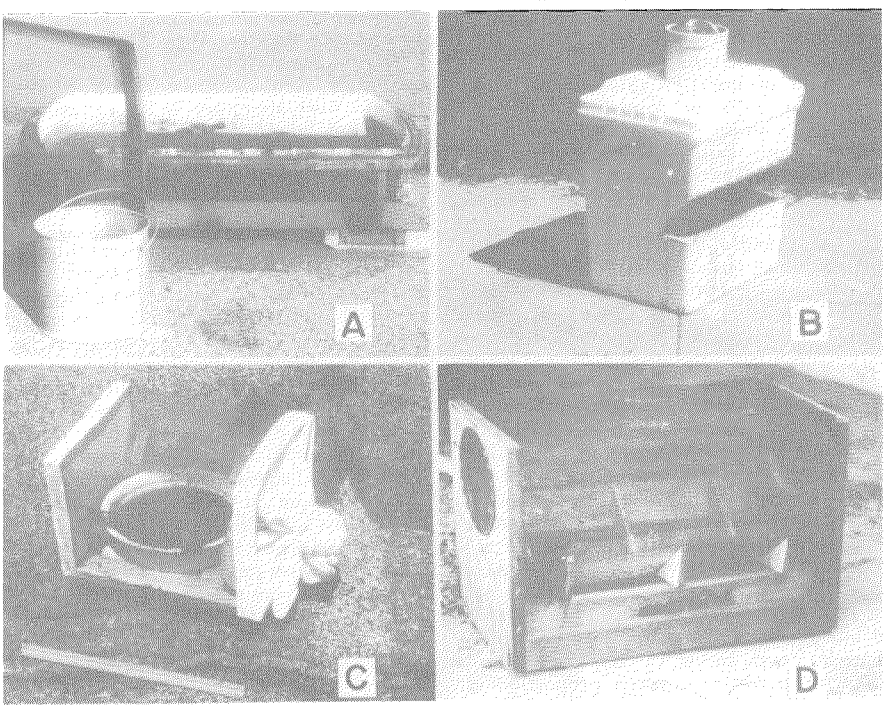

FIG. 1. A. Tank used for maturation of an alfalfa pellet infusion. B. A louvered Styrofoam trap. C. A screen cage converted to a louvered trap. D. A louvered screenwire trap that snugly encompasses a rectangular vessel which rests on the ground.

crocurrents of air or odors. Thus to retain a high percentage of the entering females, we had to design the louvers and traps so the seeking abilities and tendencies of the ensnared females lured them away from or caused them to bypass openings in the louvers. A combination of screenwire louvers with narrow slits at the apices or with the apices somewhat hooded by an upward bend or curvature of the projecting bottom screens of the louvers plus some screened headroom above the louvers proved successful in retaining a high proportion of entrapped females. Apparently light and air or odors through the screens tended to keep the females from detecting and thus escaping through openings.

Traps placed close to even moderate concentrations of ants were subjected to severe predation from the pests. We successfully evaded such encroachments by smearing odorless petroleum jelly on and around the point of insertion of spike nails that served as stilts or legs on traps with wooden bottoms into which the spikes were driven. Equal success was obtained by placing supporting members of any type trap in kerosene- or water-filled receptacles.

We used screen wire traps of 2 designs: One was made by installing louvers in regular mosquito cages with the attractant in pans on the bottoms of the cages (Fig. 1C). The other was made to encompass snugly a rectangular, vertical-sided, rather large attractant container that rested on the ground rather than on the floor of the cage (Fig. 1D). We also used a third type of trap constructed from Styrofoam ice chests on the lids of which we installed collecting containers made from pint ice cream cartons equipped with screenwire tops and funnels (Fig. 1B). To remove the mosquitoes from the Styrofoam traps required only an exchange of cartons; an aspirator was needed to remove the catch from the screen traps. Although the use of an aspirator was more time-consuming than carton exchange, the screenwire traps did tend to retain a greater proportion of the entering females, and they were less conspicuous and somewhat less subject to overturning or tipping than the Styrofoam traps. Styrofoam traps also were somewhat more difficult to ant-proof than the wooden bottomed screenwire traps.

RESULTS AND DISCUSSION. During a 106-day period from June 6 into September, we collected 7543 *C. p. quinquefasciatus* females in a variety of traps, an average of slightly less thn 12.1 per trap night. This count included some traps that contained no females because of ant predation, many traps from which considerable escapement occurred because of poorly designed louvers, others that for investigational reasons were charged with media with less than maximum attractiveness, and a number that for survey purposes were placed in unproductive sites.

We devoted our main efforts to a total of 9 locations within the metropolitan area of Fresno: California State University of Fresno, the Roeding Park Zoological Gardens, the Fresno Museum of Natural History and Junior Museum, the grounds around our laboratory building, and the homes of laboratory personnel. These 9 locations were rather widely dispersed within the Fresno metropolitan area and probably represented a fairly good cross section of the community.

All locations yielded mosquitoes throughout the test period. Our largest catch in one night at one location was the catch of 256 females near a rather high hedge that was in bloom. Our single largest catch in one trap was the catch of 101 females on August 1 at California State University, Fresno. Quantitatively, our main objective was to obtain a weekly pool of 50 females per pool per locality until we had amassed a total of 25 pools. Thus trapping at most localities ceased for at least a week once a pool had been made up. In fact, the only locality where traps were operated throughout the 106-day period was at one of the homes; there we caught an average of 16.6 females per trap night, an overall total of 3653 females. Presumably the average yields from all localities would have been comparable if a like number of traps per locality had been operated during the period.

On the basis of catches in sites within locations, female *C. p. quinquefasciatus* harbored mostly in rather dense, well-watered hedges, flower beds, vines, and clumps of shrubs. In each of the sites, energy-producing foods were available either as nectar in flowers or as exudates of sap-feeding insects or the plants themselves. In addition, most or all of the sites, of course, afforded excellent resting places in multitudes of niches with favorable humidities and cover. Traps placed on or abutting lawns near favorable resting sites tended to yield the highest average catches. However, some of our larger catches on lawns occurred in traps placed several yards from resting sites, indication that the females may search grassy areas for ovipositional sites or for food.

The residential trapping localities were all more than a mile apart, each much less than a block in extent, and all somewhat typical of the residences in dozens of surrounding blocks. Therefore, an almost unbelievably large number of *C. p. quinquefasciatus* evidently emerged in 1973 in the metropolitan area of Fresno. Every adult bird, nestling, and pet that slept outdoors may well have served on a continuing basis as an involuntary host for blood sucking females. This was the case despite the fact that our trapping was done wholly within the confines of two very effective mosquito control districts. In that regard, in no instance did we discover the breeding sites of the populations we were trapping, a further indication of the extreme cryptiveness of the species and of the difficulty which that characteristic causes control districts.

Although additional experimentation undoubtedly will yield more efficient traps and ovipositional lures, we believe that those discussed here provide investigators with new and much greater capabilities than they had heretofore for amassing fundamental information about many phases of the biology of *C. p. quinquefasciatus*. They also give control districts new tools for estimating population densities.

ACKNOWLEDGMENT. We gratefully acknowledge the encouragement and advice given to us in reviews by A. Ralph Barr, Professor of Medical Entomology, School of Public Health, University of California, Los Angeles Campus, Los Angeles, Calif., and by Richard C. Husbands, Senior Vector Control Specialist, Bureau of Vector Control and Solid Waste Management, California State Department of Public Health, Fresno, California.

References Cited

Barr, A. Ralph. 1960. A review of recent findings on the systematic status of *Culex pipiens*. Calif. Vector Views 7(3):17–21.

Barr, A. Ralph. 1967. Occurrence and distribution of the *Culex pipiens* complex. Bull. Wld. Hlth. Org. 37:293–296.

Evans, Burton R. and Edward T. Fink. 1961. Mosquito larvae recovered from cisterns and cemetery urns in seaport cities in Louisiana, Mississippi, and Alabama. Proc. Calif. Mosq. Control Assn. 39:30–32.

Lewis, Leyburn F. and Darrell M. Christenson. 1973. Influence of grids on mosquito oviposition in steel cemetery vases. Mosq. News 33(4):525–528.

Patterson, R. S., H. R. Ford, C. S. Lofgren and D. E. Weidhaas. 1970. Sterile males: Their effects on an isolated mosquito population. Mosq. News 30(1):23–27.