FIELD EVALUATION OF FIVE TYPES OF DICHLORVOS DISPENSERS AGAINST *CULEX PIPIENS QUINQUEFASCIATUS* IN CATCH BASINS[1]

G. D. BROOKS AND H. F. SCHOOF

As primary pest mosquito problems are reduced in any urban area, the secondary species become more significant. Such has been the case with the common southern house mosquito, *Culex pipiens quinquefasciatus* Say. Control measures have been applied for years against this species, but the methods used have consumed a large amount of manpower and equipment. Preliminary studies on the use of dichlorvos as a residual fumigant in catch basins (Brooks *et al.*, 1963 and Maddock *et al.*, 1963) have indicated the need for further field investigations of this technique. The objective of this study was a comparative evaluation of five types of dichlorvos dispensers for *Culex* control in catch basins.

MATERIALS AND METHODS. The following dispenser formulations of dichlorvos [2,2-dichlorovinyl (dimethyl phosphate)] were used:

a. Twenty-percent dichlorvos in polyvinyl chloride resin plastic strand, 1/8 inch diameter, applied at 20 grams of technical dichlorvos by weight of the strand.[2, 3]
b. Twenty-percent dichlorvos in polyvinyl chloride resin plastic strip, 3/16 x 2½ x 10 inch strips, containing 20 grams of technical dichlorvos by weight of dispenser unit.[2]
c. Twenty-percent dichlorvos in polyvinyl chloride resin pellets, applied at 20 grams of technical dichlorvos by weight of pellet.[2]
d. Twenty-five-percent dichlorvos in hydrophobic wax and dibutyl phthalate, a cylindrical unit containing approximately 50 grams of technical dichlorvos per unit.[2]
e. Seventy-percent dichlorvos in liquid contained in a permeable plastic dispenser, unit weight of the technical dichlorvos approximately 30 grams.[4]

Five catch basins were selected for treatment with each formulation. Adjacent to each set of treated basins, one basin was left as an untreated check. The pellet formulation was broadcast in the basins. All mounts of the liquid formulation were made above the water level. The remaining three formulations were mounted with some units entirely above and others submerged below the water surface.

To insure a basin sample which would remain positive for mosquito production through the entire season, a 48-square-block area in the southern part of the city was selected for treatment. Previous records of the Chatham County Mosquito Control Commission and of the 1962 dichlorvos study indicated intense breeding in this area from April through October. The physical features of these catch basins adhered closely to the description given by Maddock *et al.* (1963). The dispensers were suspended in each basin by means of a length of number 12 coated copper wire from a perforated metal tape hanger nailed to the top of the basin wall. The wax and liquid dispensers each required a special mounting technique. A protective plastic casing was used with the wax unit, and the

[1] From the Biology/Chemistry Section, Technology Branch, Communicable Disease Center, Public Health Service, U. S. Department of Health, Education, and Welfare, Savannah, Georgia.

[2] Furnished through the courtesy of Shell Development Company.

[3] Use of commercial products in this study does not constitute endorsement by the Public Health Service.

[4] CIBA dispenser furnished through the courtesy of the World Health Organization, Geneva, Switzerland.

liquid unit required a modified mounting bracket. Dispensers mounted above the water line were placed approximately 6 inches below the street level. Below-water mounts were wholly immersed in the water. A poison label was attached to each dispenser as a warning indicator.

Evaluation of the effectiveness of treatment was based on weekly 3-hour exposures of adults and on weekly inspections for mosquito breeding in the basin. For check purposes two cages of test mosquitoes were transported to the field with the specimens used in the exposure, and two cages were retained at the laboratory. Adult specimens of *C. p. quinquefasciatus* from a laboratory colony were used exclusively as the test insect. Approximately 100 3-day-old adults of both sexes were anesthetized and placed in a 3½ x 4-inch cylindrical galvanized wire cage. The open end of the cage was covered by finely meshed nylon netting secured by a rubber band. Cages were transported to the test area in a shallow vertical case covered with wet gauze to minimize mortality of the test insects from desiccation.

A portable suspension bar with an adjustable cord was used to hang the test cage approximately 6 inches above the water surface for the exposure period. Measurements of the water level in the basin at the time of the larval inspection permitted presetting of the cord length to the desired depth. This method of suspension also eliminated the need for opening the top of the basin at the time of exposure since the cage could be lowered through the opening at the street curbing.

Inspections for breeding using a standard 4-inch enameled dipper were made on the day prior to the adult tests. The average number of larvae per dip for three dips determined the breeding index for the individual basin.

RESULTS. With four of the five formulations three-hour exposures of caged adults resulted in acceptable female mortalities that ranged from 6 to 17 weeks (see Table 1). The time at which the average female mortality dropped below 70 percent and failed to recover was selected as the criterion of effectiveness. Acceptable mortalities were at or above 70 percent. These data indicate almost complete loss of tests on the 3rd, 4th, 8th, 9th and 12th week because of rainfall. The resin strip formulation gave 13 to 16 weeks effectiveness while the resin strand, wax, and liquid formulations yielded 6 to 15, 6 to 15, and

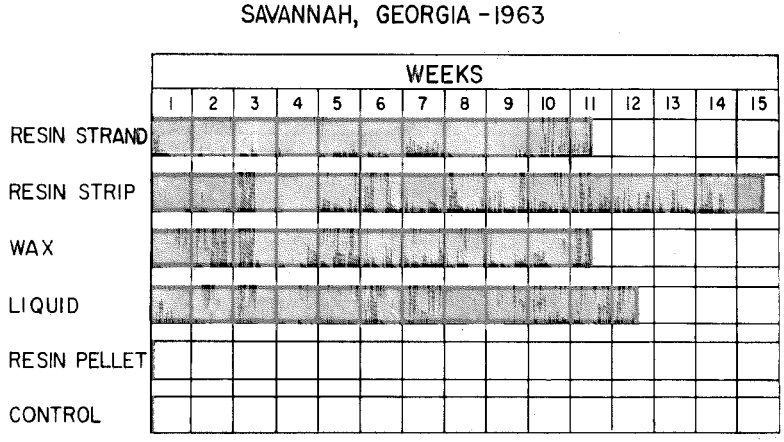

FIG. 1.—Average number weeks effective kill of adult female *Culex pipiens quinquefasciatus* in catch basins.

TABLE 1.—Percent mortalities of female *Culex pipiens quinquefasciatus* Say exposed for 3 hours to dichlorvos in catch basins.

Formulation	Basin No.	Percent ♀ mortality at indicated weeks after treatment																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Resin Strand	1	100	100	—	—	0	100	100	—	—	100	84*	—	6	2	0	0	0
	2	100	100	—	—	100	100	100	—	—	100	98	—	0	100	93*	10	0
	3	100	100	—	—	100	100	100	—	—	95*	8	—	9	69	L	0	0
	4	100	100	—	—	100	100*	8	—	—	0	0	—	0	0	0	0	0
Resin strip	1	100	100	—	—	100	100	100	—	L	96	L	—	100*	0	0	0	0
	2	100	100	—	—	100	100	100	—	100	100	L	—	100	0	100	100*	0
	3	100	100	—	—	100	100	100	—	L	100	100	—	20	85	86*	0	0
Wax	1	100	100	—	—	41	53	2	—	—	100	0	—	0	75	100*	0	63
	2	100	100	—	—	100	100*	39	—	—	9	4	—	L	0	2	0	0
	3	100	100	—	—	100	100	91	—	—	96	100	—	100	91*	26	0	0
	4	100	39	—	—	100	100	100*	—	—	0	0	—	8	47	0	0	0
Liquid	1	24	100	—	—	100	100	100	—	—	93	91*	—	0	0	0	0	0
	2	100	100	—	—	100	100	100	—	—	100	100	—	65	100	100	48	98*
	3	0	100	—	—	100	100	100	—	—	L	100	—	100*	35	37	69	0
	4	100	100	—	—	100	100	100*	—	—	0	0	—	L	0	2	0	0
	5	L	100	—	—	100	100	100	—	—	91*	14	—	2	0	0	0	0
Resin pellet	1	0	0	—	—	L	1	2	—	—	0	0	—	0	3	0	0	0
	2	3	3	—	—	0	0	0	—	—	0	0	—	0	0	0	0	0
	3	0	0	—	—	0	L	0	—	—	0	0	—	0	0	0	0	0
	4	0	0	—	—	0	0	0	—	—	0	0	—	0	0	0	0	0
	5	2	0	—	—	0	0	0	—	—	0	0	—	0	0	0	0	0
Control	1	0	0	—	—	0	0	2	—	—	0	0	—	0	0	0	0	0
	2	2	0	—	—	0	0	0	—	0	0	0	—	0	0	0	0	0
	3	2	0	—	—	0	0	5	—	—	0	0	—	0	0	0	0	0
	4	0	L	—	—	0	0	0	—	—	0	0	—	0	0	0	L	0
	5	L	0	—	—	0	0	0	—	—	0	0	—	0	0	0	0	0

* Point in time at which the formulation and dosage failed to produce further acceptable mortalities.
L Loss of test due to other causes.
— Loss of test due to rain.

7 to 17 weeks, respectively. The erratic behavior of the wax formulation in basin 1 may be partially explained by an unusual basin configuration which permitted a high rate of air exchange. As anticipated, the pellet formulation within the basin water gave no adult kill. Average number of effective weeks kill by dispenser formulation is shown in Figure 1.

Air temperatures within the basins during the test period ranged from 62° F. on the 18th week to 106° F. on the 6th week of testing. Daytime temperatures remained favorable (71° F. to 91.7° F.) for the vaporization of dichlorvos through the entire period. Water temperatures ranged well within the acceptable limits to sustain *C. p. quinquefasciatus* breeding, attaining a high of 78° F. and dropping to a low of 69° F.

Data for breeding activity show a low level at the time of treatment (Fig. 2), presumably the effect of heavy rains the week prior to dispenser installation. A peak in larval production occurred at the second week after treatment and further high points occurred on an average interval of 4 weeks through October. Increased breeding activity during the latter part of September tended to follow the normal seasonal trends for *Culex* in this area.

DISCUSSION. Four of the five formulations tested offered promise as an effective control measure against adult *C. p. quinquefasciatus*. The resin strip yielded good results with high kills for the longest average period of time. Average kills of equivalent duration were achieved in large-scale treatments with this dosage and formulation (Brooks *et al.*, in manuscript). Although the liquid formulation outlasted the resin strip dispenser by several weeks in one basin, it yielded erratic results after the 8th week. The unique design of this

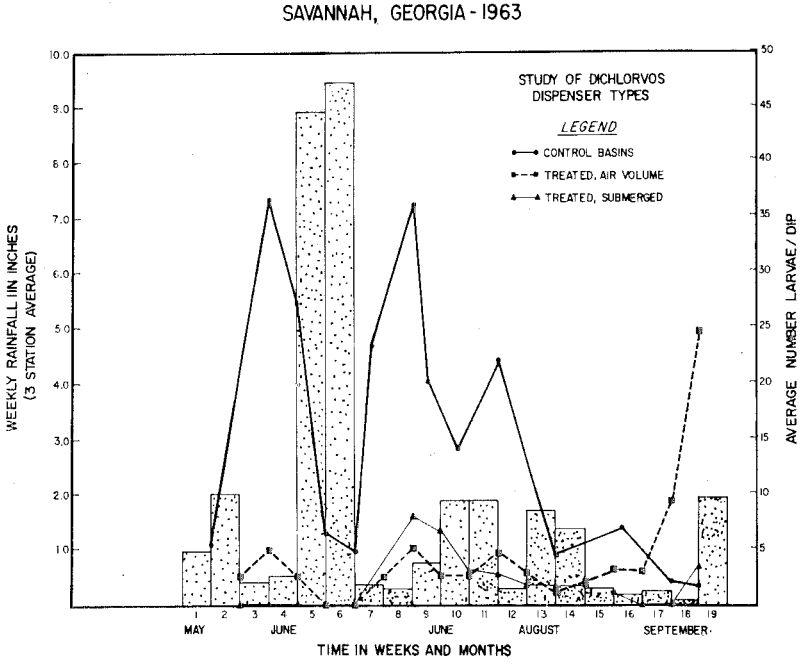

FIG. 2.—Seasonal distribution of rainfall vs. *Culex pipiens quinquefasciatus* breeding in catch basins.

dispenser offers a partial explanation to these results. The rate of dispensation of the liquid through the permeable plastic stem varied between dispensers, thus permitting rapid exhaustion of the dichlorvos reservoir in some units. As observed in previous tests with dichlorvos dispensers, low vaporization activity was noted immediately after installation in two basins. The resin strand and wax formulations displayed approximately the same range of effectiveness. The large evaporative surface on the strand apparently initiated a rapid depletion of the total available dichlorvos and, therefore, resulted in the early and complete degradation of the dispenser units. The pellet formulation gave no control of adults. Control of larvae was successful until flushing of the basin occurred. This formulation bears further investigation for use as a larvicide under conditions of less violent water movement.

The handling qualities and composition of four of the candidate dispensers indicate definite advantages of one over the other. The resin plastic strip appeared to be superior because of its tough, flexible compactness. This unit is not subject to abrasion and can be easily mounted in the basin without accessory material or casings. Although the strand affords the same inherent ruggedness, the mounting requires a degree of manipulation of the strand so as to prevent the accumulation of debris washed into the basin. Both the wax and liquid units require either a protective casing or special bracket to insure their easy installation and/or proper function.

SUMMARY. Evaluation of five types of dichlorvos formulations and/or dispensers was made in 30 catch basins in Savannah, Georgia. Considerable variation occurred in the length of residual action of the formulations. Satisfactory mortalities of caged adult *Culex pipiens quinquefasciatus* Say females exposed for 3 hours averaged 11.6 weeks for four of the five formulations, but the limits for such mortalities ranged from 6 to 17 weeks. The pellet formulation produced no adult mortalities but bears further investigation as to its potential as a larvicide. Basin infestation by immatures were found to remain low in magnitude and frequency through the 17th week.

ACKNOWLEDGMENT. The authors wish to express their thanks to Mr. John Olson, Jr., Biology/Chemistry Section, Communicable Disease Center, for his valuable assistance in the field aspects of this study. Acknowledgment also must be made to the Chatham County Mosquito Control Commission for making available information on the mosquito activity and location of the catch basins in the study area.

These studies were accomplished as part of a contractual agreement between the Communicable Disease Center and the Agency for International Development.

References

BROOKS, G. D., CARMICHAEL, G. T., and SCHOOF, H. F. Evaluation of large-scale treatment with dichlorvos for the control of *Culex pipiens quinquefasciatus* Say. (In manuscript.)

BROOKS, G. D., ELMORE, C. M., JR., SCHOOF, H. F., and CARMICHAEL, G. T. 1963. Field evaluation of three types of DDVP dispensers for the control of *Culex pipiens quinquefasciatus* Say in catch basins. Proc. N. J. Mosq. Exterm. Assoc. and Am. Mosq. Control Assoc., pp. 355–363.

MADDOCK, D. R., ELMORE, C. M., JR., and SCHOOF, H. F. 1963. Preliminary tests with DDVP vapor for the control of *Culex pipiens quinquefasciatus* Say in catch basins. Mosquito News 23(2):69–74.