

A PRELIMINARY REPORT ON THE USE OF DDT EMULSIBLE CONCENTRATE BY A MODIFIED DRIP METHOD FOR *Aedes* CONTROL

A. F. GEIB

Manager, Kern Mosquito Abatement District, Bakersfield, California

AND

GORDON F. SMITH

Entomologist, Kern Mosquito Abatement District, Bakersfield, California

The Kern Mosquito Abatement District consists of 826 square miles located at the southern end of the San Joaquin Valley of California, with Bakersfield at the approximate center. In its natural state this region is an arid semi-desert. The mean maximum temperatures for the summer months are in the high nineties and the summer means in the low eighties. The normal yearly rainfall is 5.97 inches. The Kern River, which runs through the district from northeast to southwest is dry for a large part of the year but subject to spring floods at the time of the snow pack melt in the Sierra Nevada Mountains.

Normally, this area would have no mosquito problem except along the river where *Aedes* could develop during the spring floods, and *Culex* and *Anopheles* from the time of the floods till the river dries up. However, a highly intensive irrigation type farming has developed, and it is because of this and the influx of population it brought that mosquito control has become necessary both for pest relief and the control of malaria and mosquito borne encephalitis.

The type of irrigation practised in this area may well be referred to as flood irrigation. In the alfalfa and permanent pasture holdings the land is diked off into checks from 50 to 75 feet wide and as long as a half mile. Well and/or river water is poured into the upper ends of these checks and allowed to run to the lower end where it often ponds up in areas of considerable size. It is also common practice to drain from the lower end of checks to other checks in the same

field and young larvae are carried with the water. Due to the density of the soil in most of the district, water is also used in great quantities in the growing of cotton, sugar beets and vegetables. In order to wet the ground to a sufficient depth for plant growth, water may be run through one of these fields for 10 to 12 hours. In many cases the excess or tail water is simply allowed to run off onto waste land at the lower end of the field. There are also in the district several large cattle ranches of 10 square miles or more. The land on which these ranches are situated is, with minor exceptions, unimproved. It is diked off in large uneven ponds following the natural land contours, and these ponds are flooded successively from higher to lower levels. During the summer the irrigation cycle for most land except the unimproved pastures is from 10 days to two weeks, multiplying the mosquito control problem many times.

During the latter part of the season the district has, in addition to agriculture, about 7 square miles of duck clubs. These are large diked ponds which are flooded prior to duck hunting season and kept full of water until the season is completed.

All of the above practices lend themselves readily to the development of the flood water type of *Aedes* mosquitoes and, as a point of fact, larvae are commonly found at the rate of two hundred per dip and higher over areas of 100 or more acres. The *Aedes* mosquitoes most commonly found are *Aedes dorsalis* and *Aedes nigromaculis*. During the heat of the summer these *Aedes* develop with great rapidity. The junior author, during one

test in July 1946 recorded *A. nigromaculis* emergence within three and one half days after water had been put on the field. Since DDT is not effective against pupae this makes it necessary, during most of the breeding season, to work on a 2½ to 3 day time margin. The season normally lasts for about 8 to 8½ months.

During the summer of 1946 the Kern Mosquito Abatement District turned almost exclusively to the use of DDT emulsible concentrate for the control of *Aedes* mosquitoes. The only exceptions were in waters highly polluted with animal matter, such as sewer farms and dairy drains, and those cases where it is necessary to try for pupal kill. DDT has been found to be ineffective in both of these instances.

The emulsible material was selected after trial for several reasons. Since it penetrates the water it is not apt to weather off from wind and wave action in open water, and readily kills in dense clumps of grass and other vegetation where the larvae tend to gather. It is clean and easy to handle and lends itself most readily to the use of light power equipment necessary to traverse flooded lands and river bottoms. A crew need carry only a gallon or two of this material under ordinary circumstances and with water readily available from pumps and canals have sufficient larvicide available for a normal day's work.

The district is now using commercial 50 and 100 gallon units for power spraying. These units are mounted on jeeps, and on ½-ton, 4 x 4 trucks purchased from the War Assets Administration. It is at present developing experimentally other light, compact power equipment for field use. For larger water areas, where the use of ground power equipment would be too slow or uneconomical, the district owns two PT-17 Stearman airplanes equipped with 100 gallon tanks and spray booms.

Because of the short time margin and the expense of spraying by power of some of the most constant problems in the dis-

trict, it was decided to attempt the control of *Aedes* mosquitoes in these places by direct introduction of DDT emulsions into the irrigation water. This was first attempted during the latter part of 1946 season on certain of the duck ponds. Even though a great deal of mechanical difficulty was encountered in the early work with this method, the results were excellent and it was decided to attempt control in this manner on a larger scale in 1947. The emulsible concentrate used until the latter part of the 1947 season was the Military Formula purchased from the War Assets Administration. During the latter part of the 1947 season various proprietary emulsible concentrates were tried.

The first tests made late in the season of 1946 were quite crude, the first type of container being a 5 gallon can with a nail hole in the bottom and a plug to regulate the flow. These cans had to be watched closely since DDT crystal formation at the drip hole stopped the flow quickly. The next attempt was made using 5 gallon cans with plug valve gas cocks brazed into the bottom of the cans. These, too, gave a great deal of trouble due to crystallization of the DDT. However, when the cans were properly maintained the results were such that the inspector was unable to find any larvae whatever in the fields treated. The system was used on the unlevelled pastures of a large cattle ranch and about 4 square miles of duck clubs.

Before the 1947 season started, the matter of equipment was again considered. It was felt that the difficulty from crystallization was due to the high concentration of emulsible material necessary in the 5 gallon cans in order to drip sufficient DDT in the water for a kill. With this thought in mind gas cocks were brazed into 50 gallon drums to allow for greater dilution of the emulsible concentrate. However, difficulty was also encountered with this apparatus due to the plugging of the orifice with DDT crystals.

The next step was the use of a simple

siphon from a 50 gallon drum. One-fourth inch I.D. Koroseal tubing was used for the siphon and a screw type laboratory hose clamp was used to regulate the flow of the material. The end of the hose was allowed to float freely in the water. Difficulty was encountered with this device in that the tube tended to seal off at the hose clamp. To eliminate this difficulty the glass tip of an eye-dropper was heated and blown to reduce the orifice to a size which would allow 50 gallons to flow through in 24 hours at about 3 feet of head. This tip was suspended in the irrigation stream. No difficulty was encountered with this apparatus so it was further modified (Fig. 1) as a self-activating siphon. Further refinements are yet to be made on the metering tip and on an apparatus to give a truly constant head.

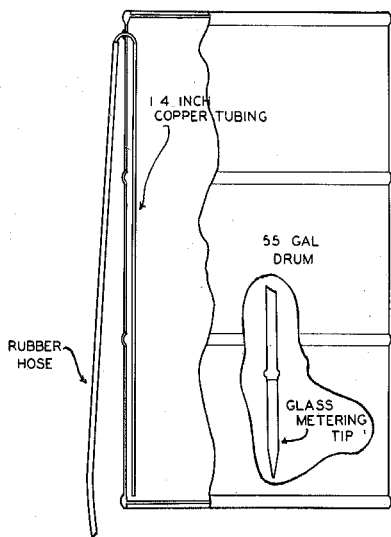


Fig. 1. Diagrammatic Sketch of Siphon Apparatus.

The apparatus as shown in the diagram was used on two large ranches in the district. One consists of 360 acres of improved and irrigated pasture. Well water is used exclusively and the soil is highly alkaline and very tight, holding water on the surface for a considerable period of

time. The other ranch is about 400 acres, partially improved and partially unimproved pasture. This ranch uses a combination of well and canal water. This canal water is brought from the river through about 15 miles of open canals. The soil is also highly alkaline and very tight. Both of these ranches are chronic trouble makers and prolific breeders of both *Aedes dorsalis* and *A. nigromaculis*.

The material used for the most part in these tests was the Military Formula. This material was purchased from the War Assets Administration and complete specifications are not available since the amount of emulsifier used was changed several times during the war. When this material is added to water it emulsifies spontaneously giving very fine particles, and remains in a completely and evenly dispersed state for a long period of time. Near the end of the 1947 season the stock of this material was depleted and several proprietary emulsible concentrates were tried but without success. They either broke due to the hardness or alkalinity of the water or rose to the top or settled to the bottom of the drum.

During the summer of 1947 the War Assets xylene concentrate was used quite extensively and met with complete success in nearly all cases.

One hundred per cent kills of emerging larvae appeared to be obtained, as none were found after careful inspection, in any of the fields treated in this manner. Concentrations of 0.15 ppm to 0.55 ppm were used in the tests and the minimum concentration necessary for kill was apparently reached in no case. Results were consistent using 0.15 ppm over a 20 day run on one ranch.

Further, the Military Formula appears highly stable after introduction to the irrigation water. Where 0.15 ppm was used on the ranch irrigated from wells exclusively, the water traveled as far as a mile in the ditch before reaching the portion of the field under irrigation. From the low end of this field the water flowed into a long slough which has, in

previous years, been a source of large numbers of *Culex* mosquitoes. After the siphon drums were set up it was unnecessary to treat this slough in any other manner for a mile and three-tenths below the field. The total carry of the DDT in the water in this case was three and three-tenths miles, including 1 mile of ditch, 1 mile of pasture and 1 and three-tenths miles of slough.

On the ranch using combined canal and well water results were comparable, using

0.15 and 0.16 ppm, to those obtained with well water though the water did not travel as far on this ranch.

Acknowledgment is due Mr. E. H. Hill, Mr. Mark W. Curtis and Mr. Everett Clinton, Inspector-Foremen of the district, without whose constructive suggestions and excellent cooperation in operating these drums and inspecting the treated areas this work would still be only in the formative stages, if it could have been attempted at all.

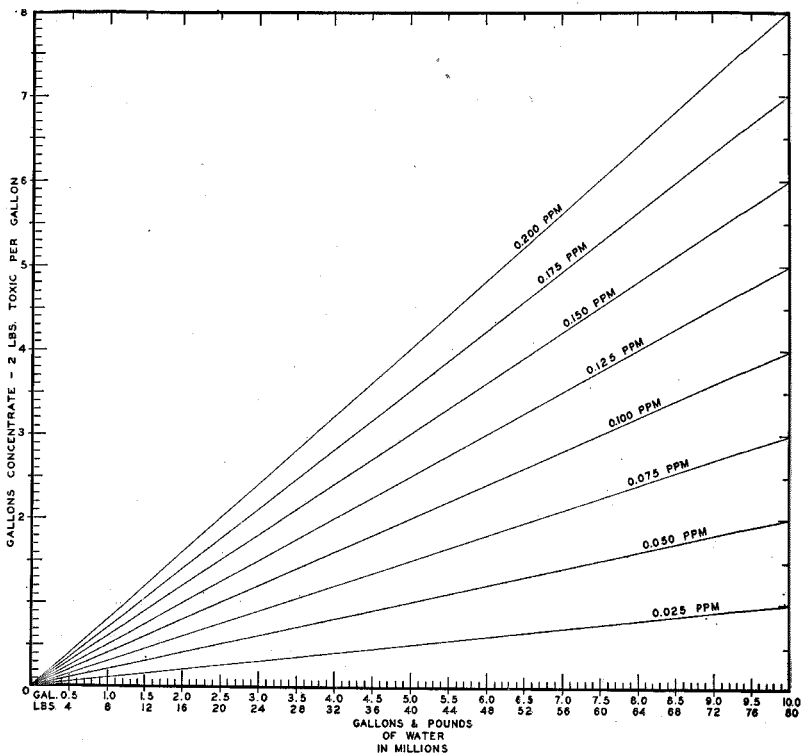


Fig. 2. Control Chart for Applying Toxics by Siphon Method.