# Chemical Control of Rice Field Mosquitoes In Mississippi

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THE INTRODUCTION and rapid expansion of rice culture in Mississippi during 1950–51 created a serious pest mosquito problem in the counties concerned. The intense mosquito annoyance suffered by communities in the rice-growing areas led the Mississippi State Board of Health to request aid from the Communicable Disease Center of the Public Health Service in developing an effective method of controlling rice field mosquitoes. As a result, a field station was established for that purpose at Cleveland, Miss., in 1952. The data reported relate to the work conducted during 1952 and 1953. All investigations were conducted in Bolivar County, Miss., which contains more than half of the entire rice acreage in the State.

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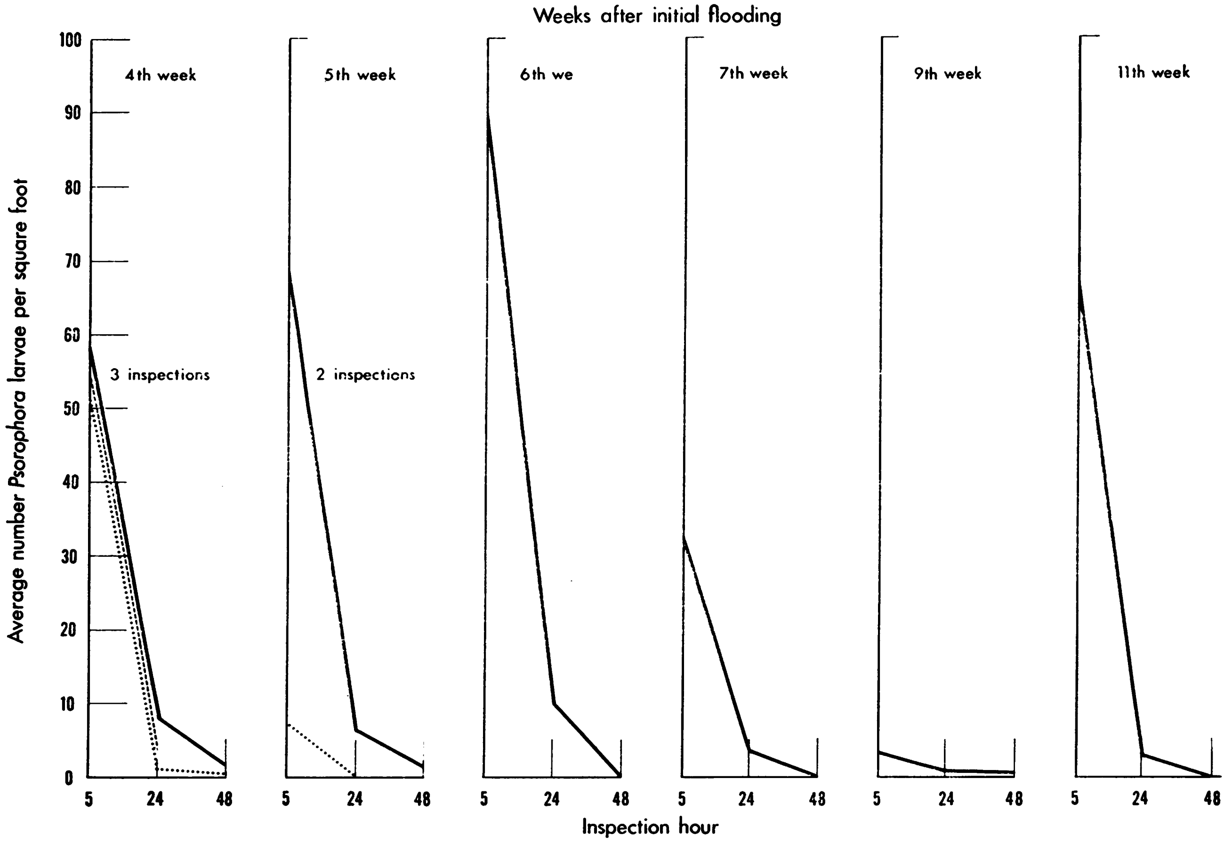
Several different species of mosquitoes breed in the rice fields of Mississippi, but *Psorophora confinnis* (Lynch-Arribalzaga) is the most important pest species. The eggs of this mosquito are deposited on moist soil. After a few days of embryonic development, they are capable of hatching within a few minutes when submerged in water (*1*, *2*). The immature stages of *P. confinnis* complete development in approximately 7 days, thus permitting a rapid buildup of the adult population under favorable conditions such as those found in rice growing areas.

In rice farming, the growers usually flood their fields throughout May and June and maintain the water levels for periods of from 4 to 6 weeks. After this time, the fields are dewatered and allowed to dry, a procedure adopted principally for the abatement of the rice water weevil, *Lissorhoptrus simplex* (Say). After the drying out period, the fields are reflooded and usually remain flooded until the grain is harvested. This cycle of water management, together with the drainage and reflooding of the fields for other cultural purposes or because of water loss through defective dikes, is conducive to heavy production of adult *P. confinnis* in the June-July period.

As the practice of dewatering the fields for control of the rice water weevil is responsible for a major part of the *Psorophora* production, and since the static inundation practices favorable for reduction of rice field mosquito breeding augment rice water weevil production, the integral interrelationship of the two problems

**Figure 1. Effects on prevalence of *Psorophora* larvae of a preflood treatment of a 101-acre rice field near Cleveland, Miss., with dieldrin emulsion applied at the rate of 1 pound of dieldrin per acre. Ten 1-foot square samples were taken in each inspection.**




is obvious. Consequently, in these studies of chemical treatments for rice field mosquito control, incidental observations also were made on their effect upon the prevalence of the rice water weevil.

## Treatment and Sampling Procedures

In 1952, 5 plots of approximately 10 acres each received a preflood treatment of a 1 percent dieldrin emulsion at a rate of 1 pound of dieldrin per acre. A similar series of plots was treated with a 3 percent DDT emulsion applied at the rate of 3 pounds of DDT per acre. Four additional plots aggregating 100 acres were given postflood applications of dieldrin-impregnated ground tobacco stems or bentonite pellets at a dosage of 1 pound of dieldrin per acre.

The emulsion formulations were applied by a tractor-mounted weed-spraying rig of a standard type. Flooding of the rice plots began 2 to 3 days after treatment. The postflood treatments were made with a Stearman PT–17 airplane equipped with a dust hopper and flying at a level of from 6 to 10 feet.

The test plots and three check areas were surveyed weekly for mosquito larvae. Two sampling devices were employed: (*a*) a metal cylinder (1 square foot) equipped with a hardware cloth bottom, and (*b*) a metal cylinder (0.5 square foot) containing a shallow cone of 60-mesh screen with a hole 1 inch in diameter at the apex and a 1-inch metal strip as the base perimenter. Both devices were placed directly over the sampling site and pressed into the soil. Trapped larvae were removed from the square foot sample with a fine mesh strainer and counted. Specimens captured by the cone cylinder remained in the narrow trough at the base of the cone when the cylinder was removed from the water and thus could be counted easily.

In addition to the weekly surveillance, portions of the plots which had been drained and reflooded 10 weeks after the preflood treatments were inspected at 24- and 48-hour intervals to evaluate the residual action of the treatments against *Psorophora* larvae.

The 1953 experiments included preflood airplane applications of dieldrin emulsion at the rates of one-half and 1 pound of dieldrin per acre to rice fields of 48 and 101 acres, respectively. A PT–17 equipped with venturi-type nozzles was used for the spraying. Two small plots (one-quarter and 1 acre) received preflood applications of dieldrin emulsion at rates of 0.25 and 0.75 pound of dieldrin per acre. Ground equipment was used in making these applications. Dieldrin-impregnated bentonite pellets which were applied by a hand-operated seeder at a rate of 1 pound of dieldrin per acre were used to treat 4 acres. In two postflood applications, pregerminated seeds were broadcast by hand after having been treated with sufficient dieldrin wettable powder to give 1 pound of dieldrin per acre.

In 1953, all sampling was accomplished with the metal cylinders equipped with a hardware cloth bottom. As the primary appraisal was for *P. confinnis* larvae, it was necessary to create conditions suitable for the propagation of this species in the test plots. At weekly intervals, selected terraces in each of the test plots were drained and maintained in this state for 7 to 10 days to permit oviposition by *Psorophora* females. The terraces were then inundated, and larval counts secured at 5, 24, and 48 hours after flooding. Similar practices were followed in the untreated fields at intervals of 24, 48, 72, and 96 hours. Weekly samples were taken in undrained treated and untreated terraces in order to measure the prevalence of those mosquitoes which oviposit in water.

To observe the effect of the mosquito control procedures upon rice water weevil infestations, samples of rice plants were examined weekly for larvae and cocoons of the weevil. The sampling technique was similar to that of Isely and Schwardt (*3*). Two to ten samples of five rice plants per sample were taken in a plot; the number of samples taken depended on the size of the field. The plants were selected at random and removed with the roots and soil attached. Each sample was washed through a set of interlocking sieves, 10-, 20-, and 40-mesh. The stages of the weevil detected in the washed residue or attached to the roots were noted.

#### Results of Experiments

The 1952 experiments indicated that preflood applications of DDT at 3 pounds per acre provided 4 to 5 weeks of effective control of *Anopheles* and *Psorophora* larvae after flooding of the fields. Dieldrin applied at the rate of 1 pound per acre as a preflood treatment gave control of *Anopheles* larvae for only 2 to 3 weeks but yielded excellent abatement of *Psorophora* larvae for approximately 10 weeks after application. *Psorophora* larvae averaged less than 1 larva per sample for the entire 10-week period. To obtain a more critical measure of the residual action of dieldrin, 3 terraces which had undergone dewatering and reflooding approximately 10 weeks after treatment were checked for *Psorophora* breeding at 24, 48, and 72 hours after inundation and again at an interval of 120 hours. The results showed a marked reduction of *Psorophora* larvae with the lengthening of the time interval as compared to continued high levels in an untreated check plot (see table).

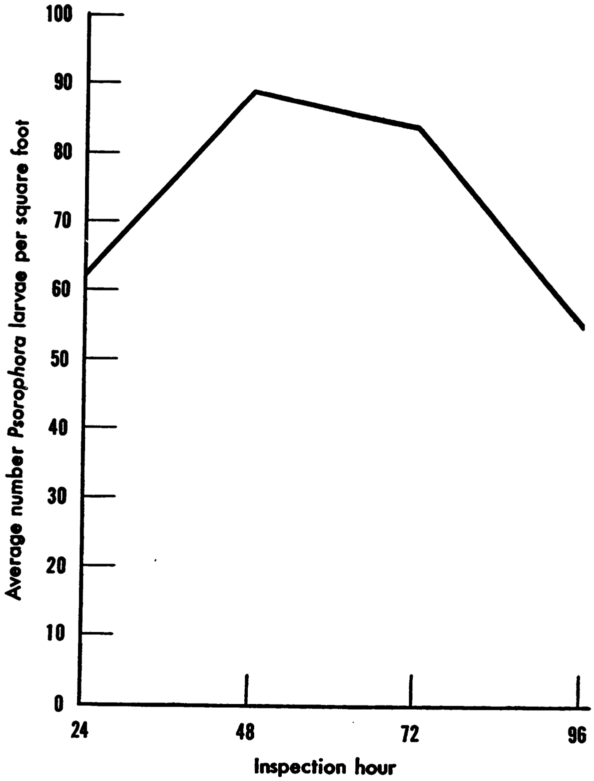
**Effect of 10 weeks' old dieldrin emulsion treatment [1] upon breeding of *Psorophora* larvae in rice terraces subject to dewatering, drying, and reflooding cycles**

| Inspection intervals | Average number of larvae per sample | | | |
|---|---|---|---|---|
| | Sub-plot 1 | Sub-plot 2 | Sub-plot 3 | Check plot |
| 24-hour | 1. 2 | 8. 6 | 60. 9 | ------ |
| 48-hour | 1. 3 | 15. 1 | 5. 8 | 67. 7 |
| 72-hour | . 1 | . 1 | 1. 4 | 69. 2 |
| 96-hour | ------ | ------ | ------ | 111. 2 |
| 120-hour | . 1 | 0 | . 1 | 69. 0 |

[1] Treated with 1 pound of dieldrin per acre.

Postflood applications of dieldrin-impregnated tobacco stems or bentonite pellets failed to give lasting control of *Psorophora* larvae. One plot treated with the dieldrin-impregnated bentonite showed an average of 9 *Psorophora* larvae per sample 4 weeks after treatment.

Figure 2. Average seasonal prevalence of *Psorophora* larvae in untreated rice fields near Cleveland, Miss., 24 to 96 hours after flooding.




Another plot showed an average of 25 *Psorophora* larvae per sample 6 weeks after treatment. Heavy infestations of *Anopheles* occurred within 2 to 3 weeks after flooding of the fields.

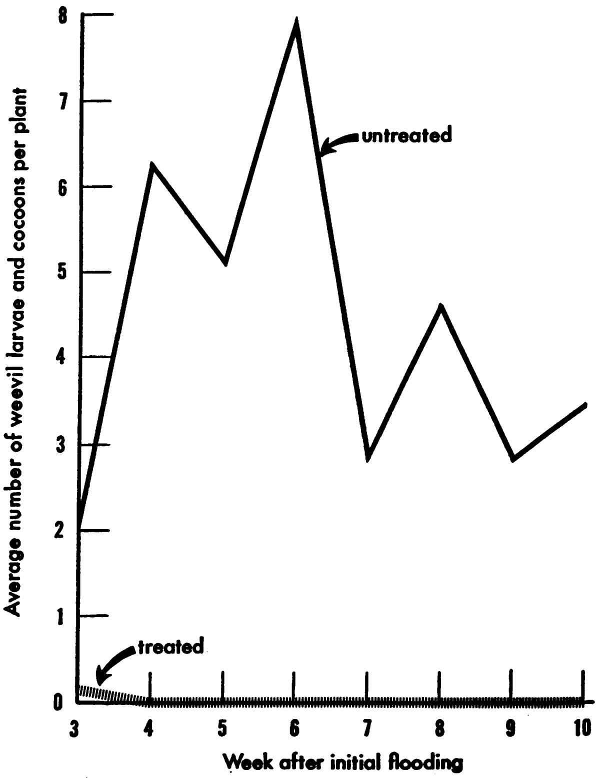
The 1953 tests demonstrated that a preflood application of dieldrin emulsion at a rate of 1 pound of dieldrin per acre would control *Psorophora* breeding in rice fields throughout the rice-growing season. As indicated in figure 1, 5 of the 9 examinations showed 100-percent mortality of *Psorophora* larvae within 48 hours after refloodings. In the untreated plots, the average number of *Psorophora* larvae showed little change during the 24- to 96-hour examinations (fig. 2).

The range of mortality in the other four inspections was from 95 to 99 percent. On the 24-hour examinations, dead larvae, and also live larvae incapable of surfacing, were often found. The indications were that a large part of the mortality occurred during the first 24 hours after flooding. No control of anopheline larvae was obtained.

Similar effective results were secured with dieldrin emulsions applied at a rate of one-half pound of dieldrin per acre as a preflood treatment. Essentially the same levels of mortality were obtained at 48 hours after flooding with both dosages, but at the 24-hour inspections the average mortality of *Psorophora* larvae in the plots receiving 1 pound of dieldrin per acre was 94 percent, as compared with 81 percent for the field treated with one-half pound of dieldrin per acre. In the latter field, the average density of larvae at the 5 hours' observation was well below that found in the field receiving the 1-pound-per-acre dosage. Again, the prevalence of anopheline larvae was unaffected by the dieldrin treatment.

In the small plot tests with dieldrin at 0.25 and 0.75 pound per acre, satisfactory control was apparent with the heavier dosage 8 weeks after the initial flooding of the field. Treatment with 0.25 pound per acre did not prevent

Figure 3. The prevalence of larvae and cocoons of the rice water weevil, *Lissorhoptrus simplex* (Say), in a rice field near Cleveland, Miss, receiving a preflood application of 1 pound of dieldrin per acre as a water application as compared to that of an untreated check field.



*Psorophora* breeding when the test plot was drained and reflooded on the third week after treatment.

Fields treated with dieldrin-impregnated bentonite pellets or with pregerminated treated seed did not display satisfactory control of *Psorophora* larvae when reflooded 4 weeks after treatment.

Excellent reductions in the rice water weevil populations for periods of 9 to 10 weeks after flooding (fig. 3) were obtained from the application of dieldrin emulsion at dosages of one-half and 1 pound per acre. In the single plot receiving a dosage of 0.25 pound of dieldrin per acre, the level of reduction obtained was considered unsatisfactory. However, both the applications of dieldrin-impregnated bentonite pellets and that of treated pregerminated seeds provided effective reductions of the weevil.

### Discussion of Results

Observations and light trap data have indicated that a relatively small number of *Psorophora* eggs overwinter and serve as "seed" for the forthcoming generation. Although few adults are present in early spring, the buildup of *P. confinnis* populations is rapid after June 1, the prevalence of the species reaching its maximum levels in early July. This increase is associated directly with the water management practices followed for the June-July period.

Because of the interrelationship of rice water weevil and *Psorophora* infestations, the control of the former by any means other than water management would be of definite benefit in the abatement of rice field mosquitoes. Under continuous flooding of the fields, the breeding area available for *Psorophora* would be reduced markedly. In addition, any chemical measure which was toxic to both insects would be more acceptable to the rice grower since its adoption would be on an economic as well as on a health basis.

The results achieved with dieldrin emulsion as a preflood treatment at one-half and 1 pound of dieldrin per acre indicate that this chemical is equally effective against both the rice field mosquito and the rice water weevil. The application of one-half pound per acre is obviously a less expensive treatment, but since it was made 4 weeks later in the season than the 1 pound-per-acre application, its effectiveness was appraised for 7 instead of 11 weeks. Consequently, while treatment with 1 pound of dieldrin per acre can be recommended as being effective for the entire rice growing season, further tests are required with the one-half pound-per-acre dosage.

Based on the current market prices of the insecticides, the cost per acre of airplane treatment at a rate of 1 pound of dieldrin per acre was $4.56. At a treatment rate of one-half pound per acre, the cost amounted to $2.73.

### Summary

Preflood aerial treatment of rice fields at Cleveland, Miss., with dieldrin emulsion at the rate of 1 pound of dieldrin per acre effectively controlled the breeding of larvae of *Psorophora confinnis* (Lynch-Arribalzaga) for the entire rice-growing season. Similar treatment at one-half pound of dieldrin per acre gave excellent control of rice field mosquito breeding during the 7-week period of appraisal.

Preflood treatments of dieldrin at 0.25 pound per acre as an emulsion and at 1 pound per acre as impregnated bentonite pellets or postflood applications of dieldrin-impregnated ground tobacco stems, bentonite pellets, or dieldrin-treated pregerminated seeds did not give satisfactory lasting control of *Psorophora* larvae.

All dieldrin treatments failed to give lasting control of anopheline larvae.

Dieldrin applications of one-half to 1 pound per acre yielded excellent reductions of the rice water weevil, *Lissorhoptrus simplex* (Say), populations regardless of the time and method of treatment.

#### REFERENCES

(*1*) Horsfall, W. R.: Breeding habits of a rice field mosquito. J. Econ. Entom. 35: 478–482 (1942).

(*2*) Horsfall, W. R.: Biology and control of mosquitoes in the rice area. Arkansas Agricultural Experiment Station Bulletin No. 427. Fayetteville, University of Arkansas, 1942.

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## From the SOCIAL SECURITY BULLETIN . . . . .

### Voluntary Health Insurance Coverage Of Aged OASI Beneficiaries

What is the extent of voluntary health insurance coverage among aged beneficiaries of the old-age and survivors insurance system? Answers to this and related questions, obtained in the course of a national survey of the economic resources of aged beneficiaries which the Bureau of Old-Age and Survivors Insurance of the Social Security Administration made in 1951, are analyzed by Dorothy McCamman and Agnes W. Brewster in an article in the August 1954 issue of the Social Security Bulletin.

Three out of every 10 aged beneficiaries had some form of voluntary health insurance. For 1 in 20, the protection was very limited, usually only an accident policy. Only 1 in 40 had anything approaching comprehensive protection against medical bills. Concentration of protection for aged beneficiaries—as for the population at large—was on hospitalization. Of all aged beneficiaries, 23 percent were insured against hospital care costs; more than half of them had no other type of policy.

As the authors point out, the techniques of group enrollment, payroll deductions, and employer participation in premiums—techniques responsible for the relatively broad health insurance coverage of the general population—are not easily applicable to persons who are no longer members of employed groups. Reflecting the greater incidence of protection among working groups, the survey found that beneficiaries whose retirement benefits had been suspended during the survey year because of earnings in covered employment were much more likely to have health insurance than were those who drew benefits all year.

Continuation of health insurance coverage on an individual basis after retirement, although not usually possible with commercial insurance, has become increasingly possible under Blue Cross and Blue Shield plans for those able to afford the non-group rates. Such characteristics of voluntary health insurance explain the survey findings that, in contrast to the unprotected group, beneficiaries with hospitalization insurance were slightly younger, had started to draw social security benefits more recently, had somewhat larger incomes from reasonably permanent independent sources, and were more likely to be receiving a pension from a former employer or union.

The size of the community in which beneficiaries live was found to have little or no relation to the ownership of hospitalization insurance. The absence of a significant urban-rural difference is explained by the fact that OASI beneficiaries—regardless of where they live after retirement—come originally from predominantly urban settings where the employment covered by the program is concentrated.

The amount of hospitalization insurance coverage among aged beneficiaries is compared with that among the total noninstitutional population aged 65 and over, as determined by a census survey in March 1952. The overall proportion insured against hospital costs was somewhat higher for the total aged group—26 percent—than for OASI beneficiaries—23 percent. Beneficiaries whose benefits had been suspended during the survey year because of employment were about as likely to have protection against costs of hospital care as were all persons aged 65 and over and still in the labor force.

An article to be published in an early issue of the Bulletin will present the findings on hospitalization rates of aged beneficiaries during the 1951 survey year.

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