FIELD EVALUATIONS OF DURSBAN® INSECTICIDE BRIQUETTES WHEN USED AS MOSQUITO LARVICIDE MATERIALS

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The idea of using briquettes impregnated with insecticide for controlling mosquito larvae is not new. Raley and Davis used briquettes impregnated with a DDT-lindane mixture for this purpose in 1949. Using briquettes made from sand, cement, and 50 percent water-wettable dieldrin, Elliot (1955) was able to control *Aedes aegypti* Linnaeus in water jugs for as long as a year. Cement briquettes impregnated with dieldrin were successfully used by Evans and Fink (1960) to control *Aedes aegypti* larvae in fire barrels for 150 days. To control mosquito breeding in rice fields, Symes *et al.* (1962) indicated the use of 0.75 percent (by weight) lindane impregnated in bricks of plaster of paris. During field tests in the Tokelau Islands using dieldrin-impregnated briquettes made of cement, Laird (1967) observed 100 percent larval mortality in all mosquito breeding sites one day following introduction of the briquettes. These briquettes continued to be effective for controlling mosquito larvae for almost 5 years. Barnes *et al.* (1967) was able to show they could impregnate briquettes (commercial charcoal, casting plaster, and a mixture of commercial ready-mix cement and casting plaster) by pipetting, topically, solutions of technical Abate and malathion upon briquettes. However, when their briquettes were exposed to a second water change the malathion-concrete formulation failed to give good control of the mosquito larvae. Further work conducted by Barnes *et al.* (1968) using Abate briquettes in woodland pools indicated that apparently 4–18 days were required for a toxic level of Abate to build up in pools before control of the mosquito larvae could be realized. Here again the briquettes were made up first, then the Abate emulsifiable concentrate was added either topically or by soaking the briquettes in an acetone-Abate solution.

There have been numerous reports on the activity of Dursban insecticide against various species of mosquitoes (Ludwig and McNeill (1966), Mulla *et al.* (1966), Gahan *et al.* (1966), Jakob (1966), Mulla (1967), Lewallen and Peters (1966), Lewis *et al.* (1966), Lewis and Christenson (1968), Kovacs *et al.* (1967), Lofgren *et al.* (1967), Steelman *et al.* (1967a), Steelman *et al.* (1967b), Steelman (1967), Sjogren and Mulla (1968), Self and Tun (1968), Miller *et al.* (1968), Taylor and Schoof (1968), McNeill *et al.* (1968), Steelman *et al.* (1969)); however, their efforts have been confined to using this material in spray, fog, or granular forms.

The purpose of this investigation was to ascertain the effectiveness of Dursban insecticide impregnated plaster of paris briquettes as a mosquito larvicide.

MATERIALS AND METHODS. Briquettes were prepared in the following manner: The required amounts of plaster, water, Dursban M insecticide and borax (which acted as a retarder) were premeasured for working efficiency because once the water and plaster were combined the mixture would begin to dry in as little as 2 minutes. For speed and efficiency, the water, Dursban insecticide, and borax were combined first. This emulsion was then added to the plaster powder all at once and stirred quickly and thoroughly. The wet plaster was immediately poured

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into a partitioned fluorescent light reflector which served as a mold for the briquette formation. The material was allowed 30 minutes to harden before the briquettes were removed from the mold.

Since various concentrations of insecticide in the briquettes were also being considered, the total amount of insecticide could be varied in the finished product by adjusting the amount of Dursban insecticide when making the emulsion. It was found that the following quantities of materials were particularly handy for making briquettes.

(a) 20 pounds plaster (dry) 9080 grams.
(b) 200 fluid ounces water
(c) 1 ounce borax
(d) 2.0, 3.7 or 7.5 fl. oz. of Dursban M insecticide for preparation of 0.25, 0.50, or 1.00% briquettes respectively.

The sections of the fluorescent light reflector produced 1.5 inch cube briquettes which weighed approximately 65 grams each. Thus a mixture using 20 pounds of plaster produced about 170 briquettes that weighed approximately 10,780 grams (24 lbs.).

Standard recommendations for amounts of Dursban M insecticide to be applied per acre for temporary mosquito control range from 0.4 fl. oz. in open areas to 1.6 oz. in areas of dense vegetation. However, since Dursban insecticide is released very slowly from the briquettes, much higher applications of the insecticide per acre were possible without overdosing. These higher dosages were required if the long-range control hoped for was to be achieved. The following application rates were used. One 1 percent briquette per 450 gallons of water or 1 percent briquettes placed 7.5 feet apart using 756 briquettes per acre (1 lb. active ingredient/acre); one 0.25 percent briquette per 150 gallons of water or 0.25 percent briquettes placed 4.5 feet apart using 2,268 briquettes per acre (0.75 lb. active ingredient/acre).

TEST SITES. In an effort to make a series of tests over a wide range of conditions to determine the effectiveness of the Dursban insecticide briquettes for mosquito control, tests were conducted at Naval Air Station, Jacksonville, Florida; Naval Station, Key West, Florida; Naval Facility, Grand Turk, B.W.I., and Roosevelt Roads Naval Air Station, Puerto Rico.

RESULTS. Naval Air Station, Jacksonville, Florida Test 1. On 17 February 1969 a standing water pool breeding *Culex quinquefasciatus* was treated with one (1 percent) Dursban insecticide briquette (by weight) at a rate of one briquette per 150 gallons of water. A 55-gallon barrel was maintained near the barracks in a shaded area as an untreated control. The initial water level of the pool was 4.5 feet and fluctuated to levels as low as 18 inches. In the preceding 2 years, this site was known to produce mosquitoes except when treated at bi-weekly intervals with oil. In April the pool was pumped dry.

No mosquito larvae were found to reappear in the test pool or in the control during the entire test period. Failure of mosquitoes to become established in the control was attributed to the fact that the pool, which was the only nearby source of mosquitoes, was abruptly brought under control.

TEST 2. On 12 May 1969 a standing water pool, 3 ft. by 5 ft. by 2 ft., was discovered with mosquito larval counts 20 to 40 per dip. The larvae were identified as *Culex quinquefasciatus*. The pool was treated at a rate of one briquette (1 percent) per 150 gallons of water. The water level fluctuated only a few inches during the test period.

After 24 hours a 50 percent reduction in larval counts occurred with 100 percent mortality being observed after 48 hours. The plot was checked biweekly from 12 May to 1 October 1969. No further breeding occurred after the initial kill while similar adjacent pools continued to be reinvaded by mosquitoes. The time required to obtain 100 percent mortality appeared to be delayed by abundant debris and organic matter within the test plot.

TEST 3. At Naval Air Station, Jacksonville, a ditch 175 yards in length with an average depth of 8 inches was treated with one 1.0 percent briquette every seven paces, or approximately each 20 feet. Prior to treatment the larval count averaged 12 per dip with the exception of one hole which had an average of 60 per dip. Mosquito larvae collected from the ditch were identified as *Psorophora ciliata* and *Culex nigripalpus*. Following treatment weekly observations were made even though rainfall was insufficient to maintain mosquito breeding.

Complete mortality occurred within the first 24 hours. No larvae were observed during the following 4 months even though there was standing water intermittently due to rains.

NAVAL STATION, ROOSEVELT ROADS, PUERTO RICO. An isolated stagnant pool approximately 20 by 10 ft. was found to have abundant *Culex* spp. larvae (50–100 per dip). The pool was treated 27 March 1969 with 0.25 percent Dursban insecticide briquettes at a rate of one briquette per 150 gallons of water.

No live mosquito larvae were observed after 2 hours. Small crabs and aquatic insects other than mosquitoes and midges showed no apparent ill effects even after 5 days. After 5 months no reinfestation had occurred and larger aquatic insects were still healthy.

GRAND TURK, B.W.I. On 19 February 1969, treatment areas (temporary pools) were selected from the Naval Facility Area, Cockburn Town Area. *Aedes taeniorhynchus* was the principal pest mosquito. The three treatment sites were selected in areas where mosquito larvae had been observed or collected previously.

Treatment plots received rain on five different occasions during the test period. The amounts varied from 0.75 to 2.64 inches.

Good control was achieved until the initial treatments became diluted by an unusually heavy rainfall and subsequent increases in water level.

On 20 July 1969, during a dry period, soil samples were taken at the Naval Facility Treatment site and an adjacent untreated breeding site. No larvae hatched from the soil samples at the Dursban insecticide treated site but soil samples from the adjacent untreated area produced *Aedes taeniorhynchus* larvae.

KEY WEST, FLORIDA. On 11 March 1969 several sites were treated with 1 percent Dursban insecticide briquettes near the Naval Communication Station on Saddle Bunch Key. *Aedes taeniorhynchus* mosquito larvae were present in heavy populations at all sites. The sites were treated at a rate of 1.0 lb. actual toxicant/acre.

Four hours after treatment, 95 percent mortality was observed; after 24 hours, 100 percent mortality was produced. The pupae present were apparently unaffected, but the adults died during emergence. The dead adult mosquitoes were so numerous that from a distance the water surface had a sheen similar to that produced by an oil slick. Adjacent infested areas served as good check plots.

The original treatment was 100 percent effective for approximately 2 months at which time heavy rains flooded the site and a light population of larvae (2–5 per dip) was noted. Untreated adjacent areas had approximately 50 larvae per dip. By 20 June 1969 the briquettes had eroded to about one-quarter their original size due to flooding and tidal action.

SUMMARY. Tests conducted at Naval Air Station, Jacksonville, Key West, Grand Turk, and Puerto Rico demonstrated that Dursban insecticide impregnated plaster of paris briquettes offer an effective means of controlling mosquito larvae in temporary pools, pot holes, and small isolated swamps and salt marshes. Dosages applied in the tests were calculated based on the total amount of toxicant in the briquettes, and ranged from 0.75 to 1.5 pounds actual toxicant per acre. These dosages were considerably higher than the maximum (0.05 lb/acre) dosage registered by the USDA. Evidently because of a slow release rate from

the briquettes, important aquatic organisms such as crabs, minnows, etc., were not harmed.

In larger salt marsh areas the briquettes were not effective because there was no way to determine an adequate dosage. Frequent flooding caused dilution, and tidal action eroded the briquettes and caused a rapid loss of the toxicant.

It is evident from the data obtained that mosquito larvae can be controlled with this formulation under certain conditions with a minimum danger to wild life.

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